

DBLCC, Double Cover Box (figure 2-7)

This box consists of a body tube and two covers. Unless otherwise specified Type I covers, three inches deep, are to be used.

IC, Interlocking Double Cover Box (figure 2-7)

This box consists of a body tube with top and bottom flanges and two interlocking covers. The body shall be SW or DW fiberboard, scored, slotted, and stitched to form a tube having double scored short flanges which form a lock with the flanges of the cover (fig 2-10). The top and bottom covers shall be secured with horizontal straps. Unless otherwise specified the flanges shall be 3 in. wide for boxes made with single-wall fiberboard and 4 in. wide for boxes made with double-wall fiberboard.

FTC, Full Telescope Box (figure 2-8)

The box consists of a body and a snug fitting cover. The flaps of both may be positioned in one of 3 possible combinations. This style of box, when closed, has a triple thickness of fiberboard on all four corners, affording good stacking strength.

Type CF (corrugated fiberboard) can be obtained in grades 3, 5, 6, 11, 13, and 15, with compliance symbols of V3c, W5c, W6c, V11c, V13c, and V15c. The small "c" indicates corrugated fiberboard.

FTHS, Full Telescope Half Slotted Box (figure 2-8)

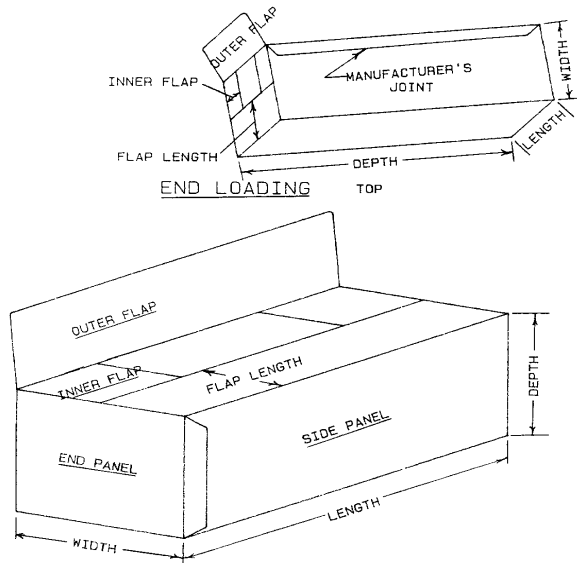
The box consists of a body and a telescoping cover, each constructed of one piece of scored and slotted fiberboard. The box dimensions shall be the inside measurements of the assembled box body. The cover shall be a snug fit on the body. The flaps along the longer edge of the box openings are the outer flaps and those along the shorter edge are the inner flaps. Flaps shall not project beyond an edge of the box. All flaps shall be of equal length with the outer flaps meeting in the center of the box but shall not overlap. A gap not to exceed 1/4 in. (6m.m.) will be permitted unless otherwise specified.

OPF, One-Piece Folder Box (figure 2-8)

When this box is closed, the outer flaps must meet. Unless otherwise specified, the inner flaps will not be less than 2 inches long for folders under 18 inches and over in width. this style is also known as a book wrapper.

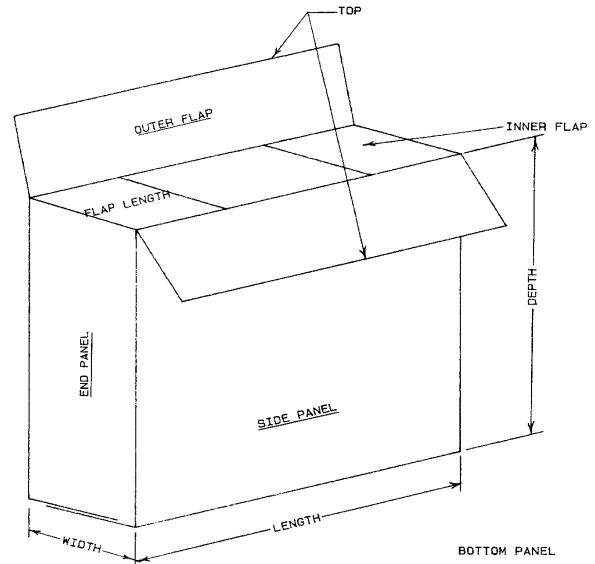
TS, Triple-Slide Box (figure 2-9)

This design, made from corrugated fiberboard only, is identified by the arrangement of corrugations in which all corrugations run at right angles to the score lines in all parts of the box. It consists of three slides, each of one piece of corrugated fiberboard, scored so as to cover completely four faces of the box. The joint of the inner slide will be left open. The middle slide will be taped at the body joint and will be a sliding fit on the assembled inner and middle slides.



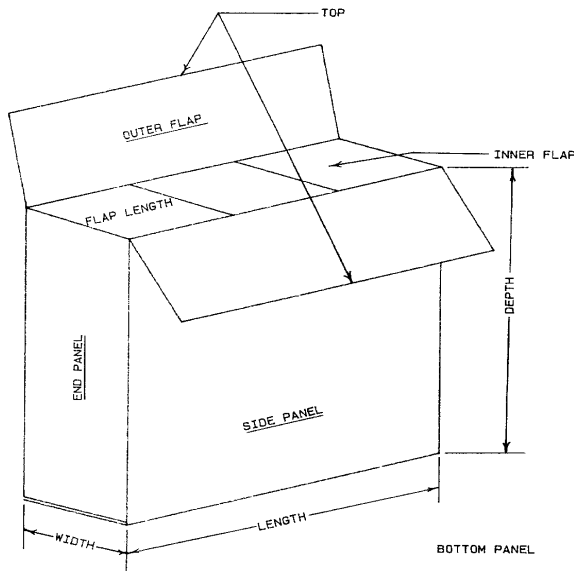
TOP LOADING
OUTER FLAPS MEET; INNER AND OUTER
FLAPS ARE OF EQUAL LENGTH

Box, Fiberboard; RSC—Regular Slotted Box



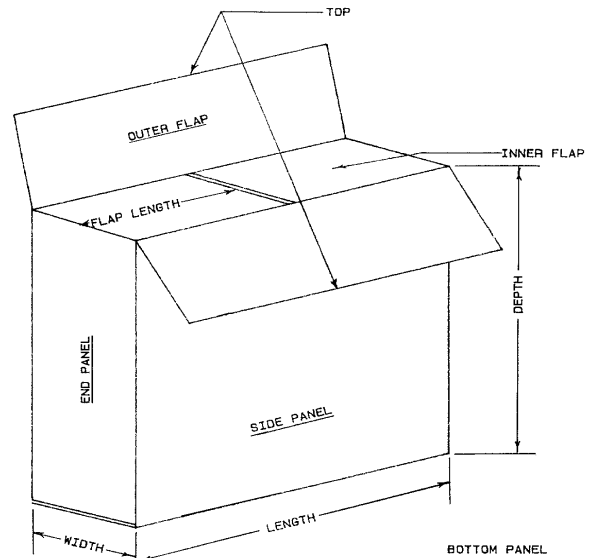
OUTER FLAPS OVERLAP AS SPECIFIED; INNER
FLAPS SAME LENGTH AS OUTER FLAPS

Box, Fiberboard; OSC—Overlap Slotted Box



OUTER FLAPS FULL OVERLAP (SEE DETAIL REQUIREMENTS)
INNER FLAPS SAME LENGTH AS OUTER FLAPS

Box, Fiberboard; FOL—Full Overlap Slotted Box

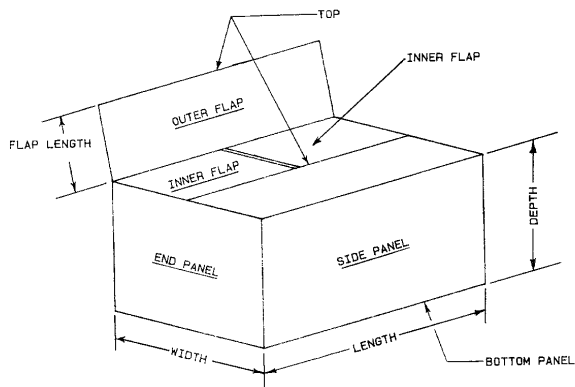


OUTER FLAPS FULL OVERLAP
(SEE DETAIL REQUIREMENTS)
INNER FLAPS MEET IN CENTER

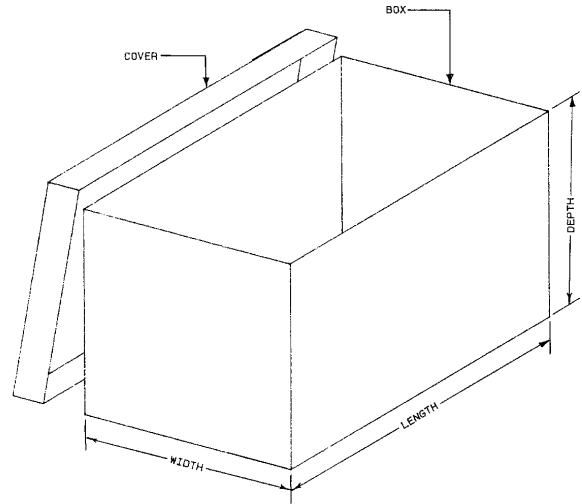
Box, Fiberboard; SFF—Special Full Flap Slotted Box

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Figure 2-6. Styles of fiberboard boxes.

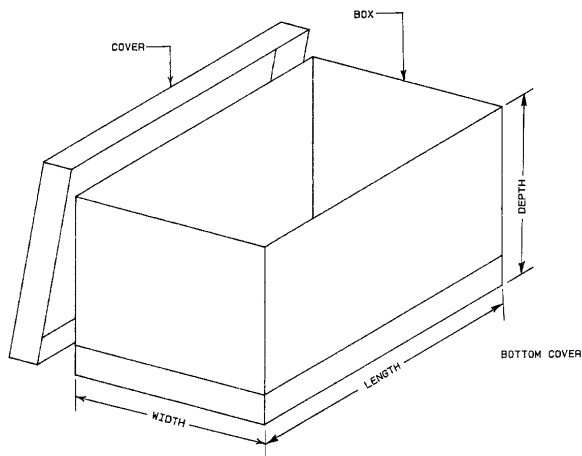


| | |
|---------------------------|-------|
| OUTER FLAPS MEET | CSSC |
| INNER FLAPS MEET | |
| OUTER FLAPS OVERLAP | CSOSC |
| AT RANDOM NO FLAP CUTTING | |
| INNER FLAPS MEET | |

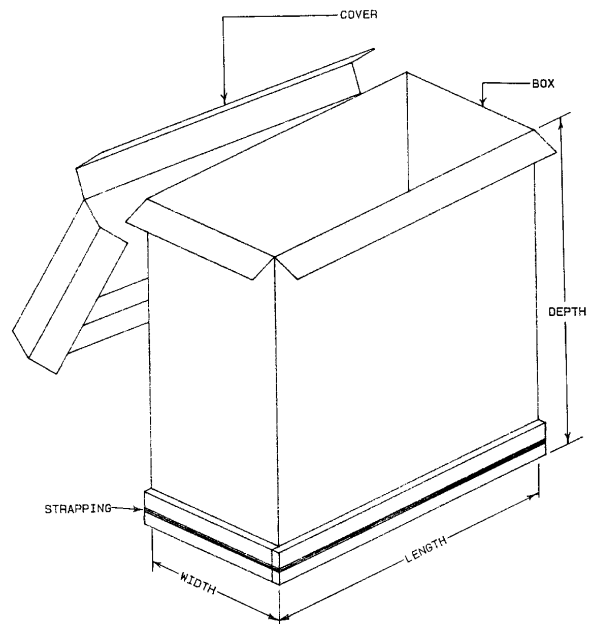


Box, Fiberboard; HSCC—Half Slotted Box with Cover

Box, Fiberboard; CSSC—Center Special Slotted Box and CSOSC—Center Special Overlap Slotted Box



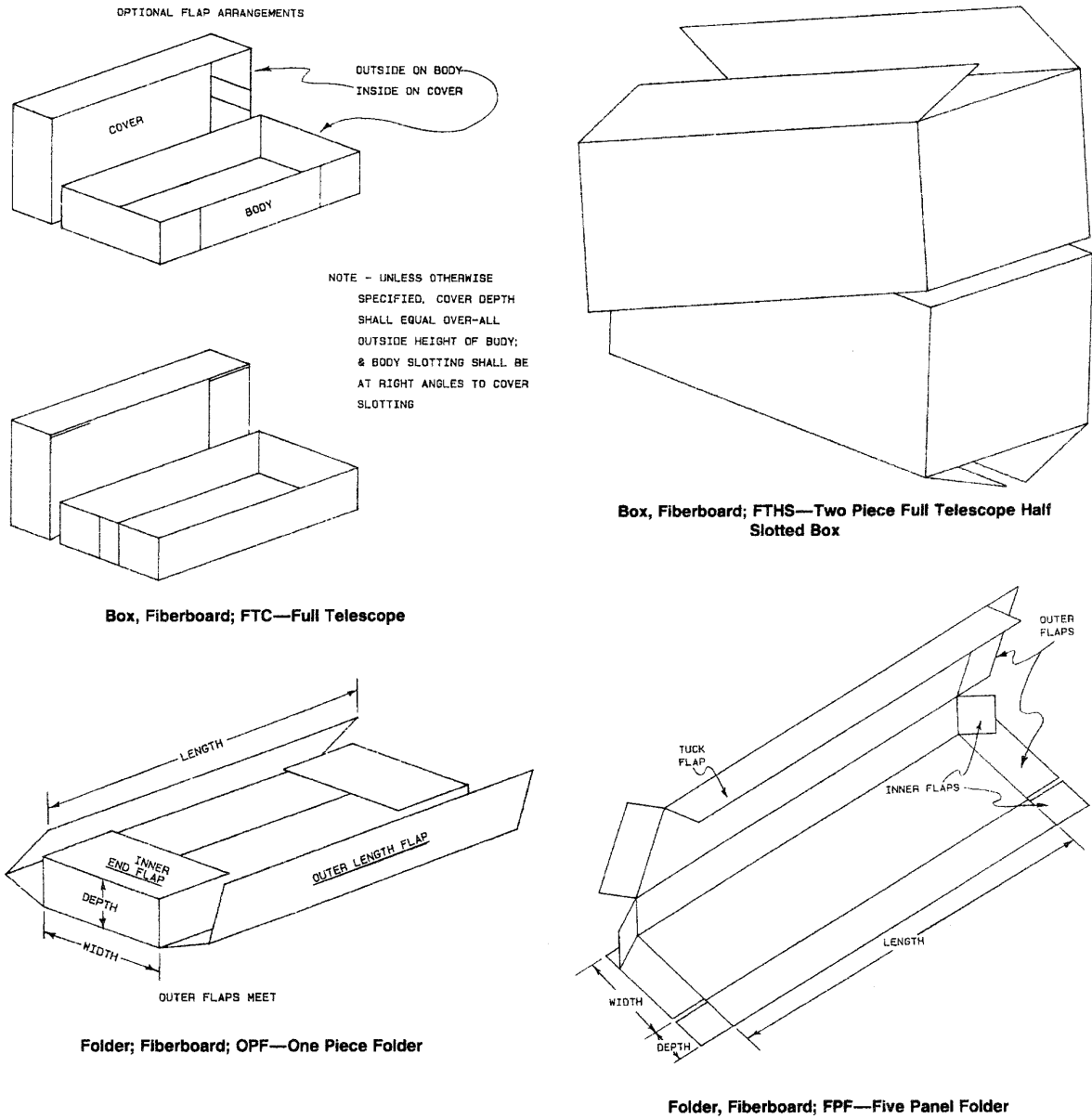
Box, Fiberboard; DBLCC—Double Cover



Box, Fiberboard; IC—Interlocking Double Cover

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Figure 2-7. Styles of fiberboard boxes.



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Figure 2-8. Styles of fiberboard boxes.

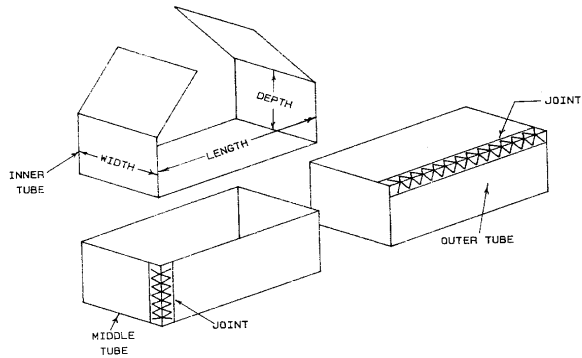


FIG. 13 Box, Fiberboard; TS—Triple Slide Box

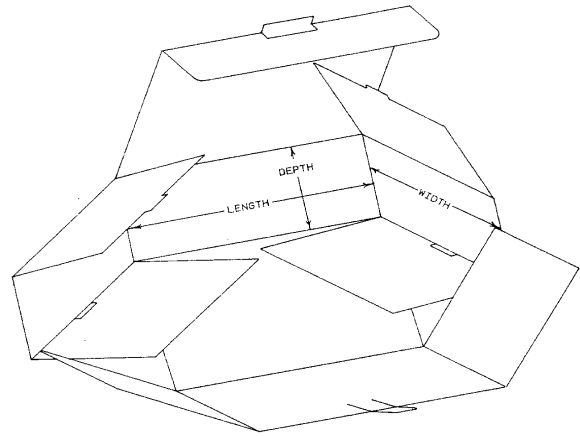
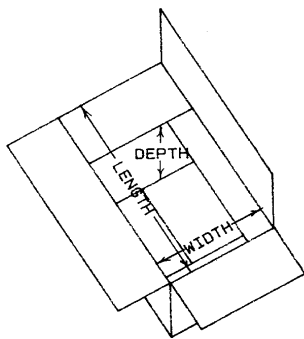
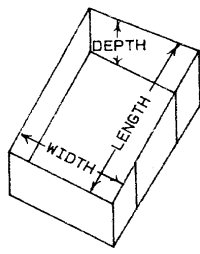


FIG. 14 Folder, Fiberboard; TSC—Tongue and Slot Closure



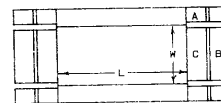
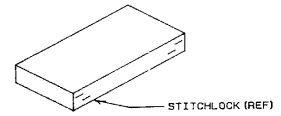
BOX BODY WITH FLAPS



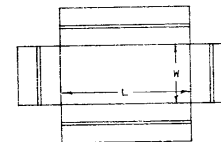
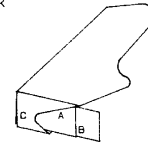
BOX BODY FOR FULL TELESCOPE CONTAINER



TYPE I STITCHLOCK



TYPE II FRICTION LOCK



TYPE III FLANGE INTERLOCK

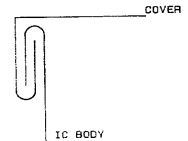
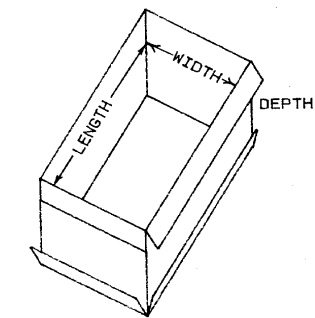
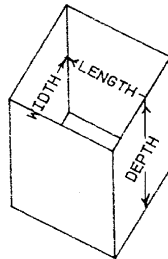


FIG. 16 Cover Assembly



BOX BODY FOR INTERLOCKING DOUBLE COVER



BOX: BODY

FIG. 15 Fiberboard Box Dimensioning

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Figure 2-9. Styles of fiberboard boxes.

FPF, Five Panel Folder Box (figure 2-8)

This design consists of a single scored slotted sheet. When set up the outer end flaps will fully overlap. This box is used to an advantage in the packing of stacked or nested items which can be arranged on the flat scored sheet and when in position, the box is folded over the contents.

TSC, Tongue and Slot Closure Box (figure 2-9)

This box is constructed of one piece fiberboard, scored and slotted as shown.

Sleeves (fig 2-11)

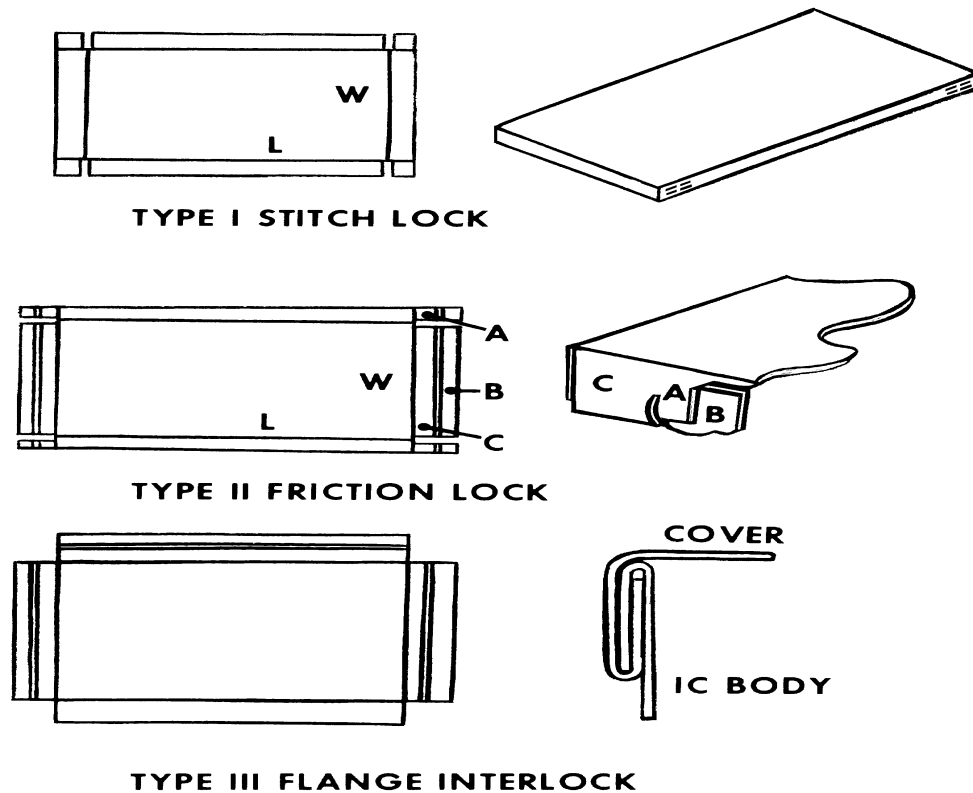
A sleeve may be specified for use with any of the box styles to provide added strength. Sleeves will be made from class weather-resistant fiberboard of the same type and grade as the box. A sleeve will closely fit the box over which it is placed and will cover the top and bottom, and both ends. The length of the sleeve (length of the stapled joint) will be the same as the inside width of the box. Unless otherwise specified, the corrugations will be at right angles to the score lines. If a butt joint is used it may be taped or the overlap joint may be stapled, stitched or glued. Alternatively, the location of the body joint shall be in the center of the top or bottom panel, providing the joint does not interfere with the required marking.

Liners (Fig 2-12)

Liners are made from one piece of fiberboard. They are scored to cover the end and side panels of the boxes. The height of the liners shall be the full inside depth of the boxes for which they are intended and the ends of the liners shall be about in the center of the side panels of the boxes.

Unless otherwise specified, liners for class domestic boxes shall be constructed for double-wall fiberboard, grade 275. The joints shall be secured with minimum 2 inch wide tape conforming to A-A-1492, A-A-1671. Liners shall be constructed from the same class of material as the boxes themselves.

Unless otherwise specified liners for class weather-resistant boxes shall be constructed of V15c fiberboard. When specified grade W5c, W6c, V3c, or V13c shall be used. Liners fabricated from single-wall fiberboard shall be A or C flute and liners fabricated from double-wall fiberboard shall be any combination of A, B, or C flutes, except BB flutes shall not be used. The flutes shall be perpendicular to the box openings (as shown in fig 2-12). The joints shall be secured with minimum 2-inch wide tape running not less than three quarters the length of the joint.



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Figure 2-10. Cover assemblies.

BOX MAKER'S CERTIFICATE (FIG 2-13)

Each fiberboard box will be plainly marked with the box maker's certificate, signifying compliance with the requirements of the applicable freight classification rules. Type CF and type SF, class domestic boxes are not required to be marked as being in compliance with ASTMs. There is no objection to marking boxes that are manufactured in compliance with the specification. Types CF and SF, class weather-resistant boxes, in addition to the box maker's name, will be marked with the date of manufacture expressed in month and year, such as 7-93; the identification symbol, such as V3s; and the specification compliance data and the minimum average bursting strength guaranteed in excess of...PSI. The figure to be inserted should be that corresponding to the dry mullen requirements in ASTM D 4727 for the particular grade of fiberboard used. For shipments to Government agencies include the national stock number (NSN), inside dimensions and outside cube marked below the specification data on all exterior boxes procured as an item of supply.

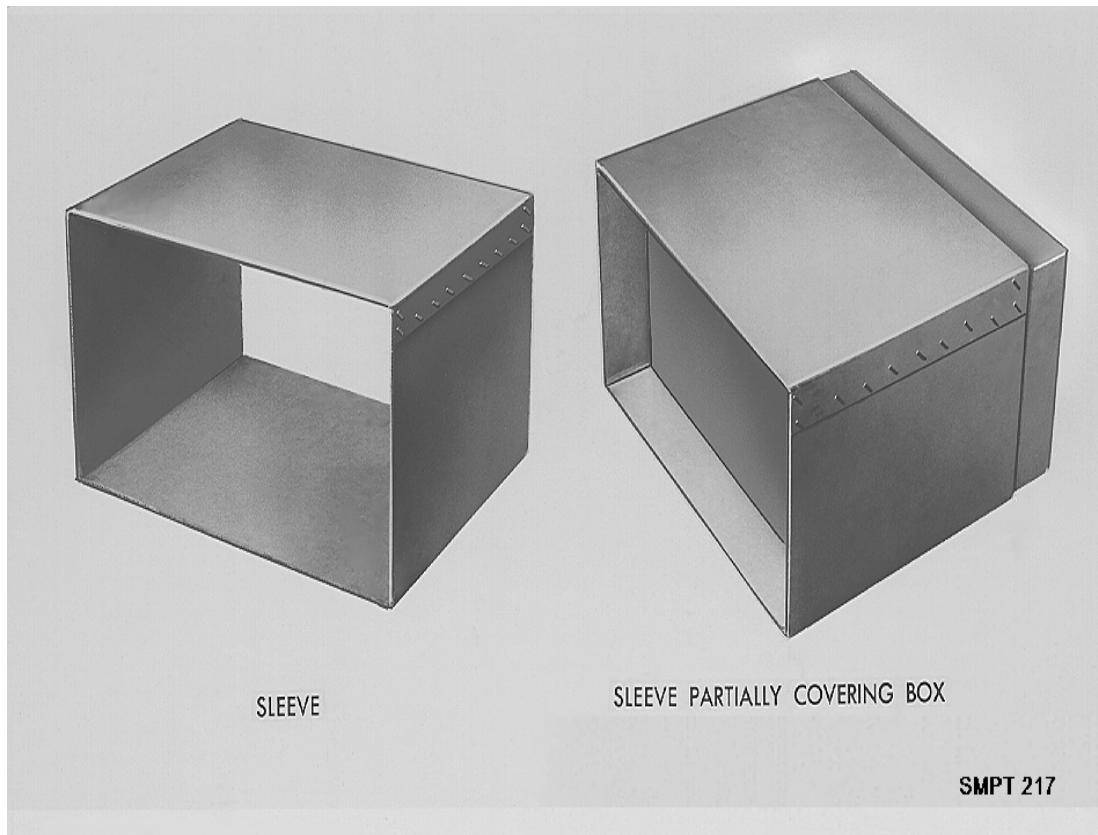


Figure 2-11. Use of fiberboard sleeve.

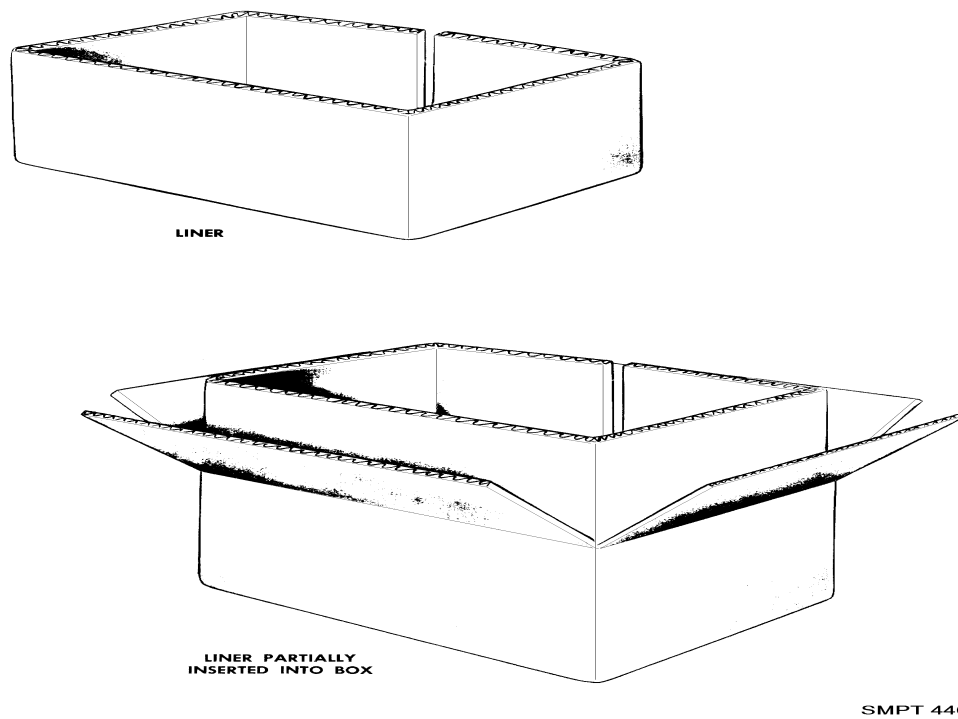
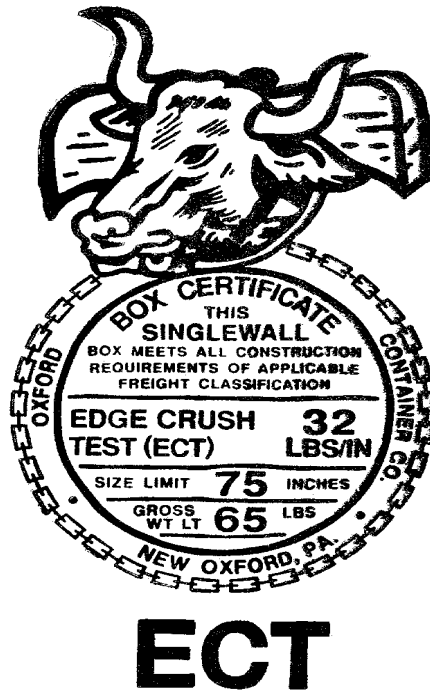


Figure 2-12. Use of fiberboard liner.



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Figure 2-13. Sample of box maker's certificate.

Closure Requirements

All boxes should be securely closed. Inner and outer flaps of slotted style boxes should be drawn together as closely as possible to insure proper closure. The lengthwise flaps should meet on (RSC, CSSC, DSC) or overlap on (OSC, CSOSC, FOL, SFF), as specified. The flaps should not project over the side or end edges, and the application of adhesive or metal stitches should be such as to prevent lifting of free edges and corners of outer flaps on assembled boxes. ASTM D 1974, standard practice for methods of closing, sealing, and reinforcing fiberboard shipping containers describes several methods to close seal and reinforce solid and corrugated (excluding triple wall) fiberboard.

Solid and corrugated fiberboard (excluding triple wall) boxes will use the methods for closure, sealing, and reinforcing which are described in ASTM D 1974, Standard Practice for Methods of Closing, Sealing and Reinforcing Fiberboard Shipping Containers. The ASTM lists, by box style, the appropriate closure method use of adhesives, tape, stitches/staples. For each methods listed, details concerning the amount of adhesive required, or the type and size of tape used, or the number pattern of stitches/staples for that methods are indicated. For example, to close a 12" wide (inside width) RSC container for government use, using stitches/staples, ASTM D 1974 indicates a closure method 2D3 may be used. The staples must have a 1/2" crown and be evenly distributed where the inner and outer flaps overlay each other. The number of 1/2" staples required to close the container is taken from the ASTM D 1974 table one referenced in the 2D3 method. (See table 2-7). The left column of the ASTM D 1974 table indicates the inside width of the box - in our example 12". Read to the right from our box width until it intersects with the column for closure method 2D3. Ten 1/2" staples or fasteners are

required for each end of the box. The pattern required for even distribution per closure method 2D3 is indicated in figure 2-14. Figures 2-15 through 2-19 provide examples of the closure methods for fiberboard boxes.

There are four methods of box sealing, Methods A through D (fig 2-19). They are described in section 7 of ASTM D 1974. Within each sealing method, the type of material authorized, its size, and its location on the box are specified.

Application of reinforcement (figure 2-20)

When only one band is required on a box in given direction, it shall be centered except in the case of lengthwise bands on styles RSC and CSSC boxes. On these styles the lengthwise band shall be offset slightly from the seam formed by the top and bottom flaps in the closed position. When two or more bands are used around the box in the same direction they shall divide the box into units of equal length. Cross banded boxes shall have the longer band applied first. Boxes carrying loads having restricted points of contact shall be banded, wherever practicable, over these points of contact. Bands shall be applied straight and shall be sufficiently tensioned. Metal bands shall be embedded into the edges of the box, but shall not cut or tear the fiberboard or crush the contents. When a sleeve is specified the bands shall be applied after the sleeve is placed on the box.

Metallic and nonmetallic strapping requirements are listed in table 2-8. The required number of reinforcing bands are identified in table 2-9.

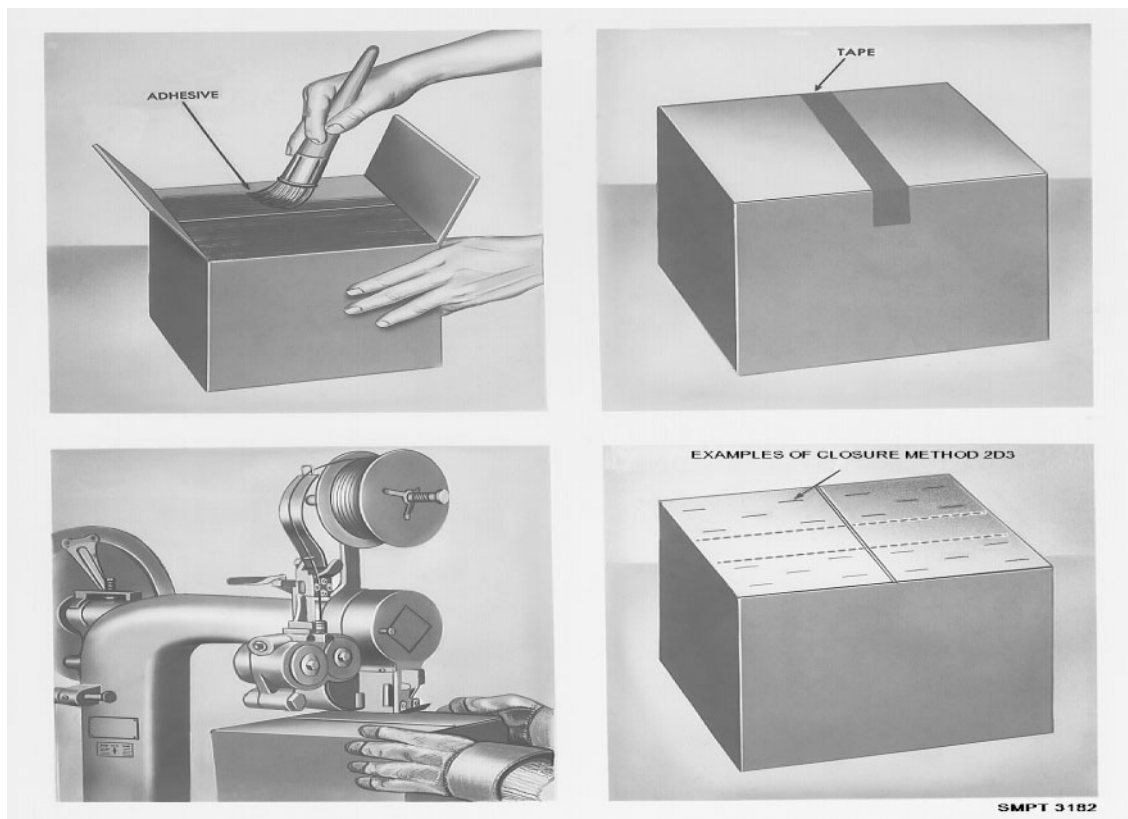


Figure 2-14. Closure of class weather-resistant and WWVR fiberboard boxes with adhesive and/or stitches.

Table 2-7 Number of 2 in. Crown Staples or Stitches for Regular Slotted Containers

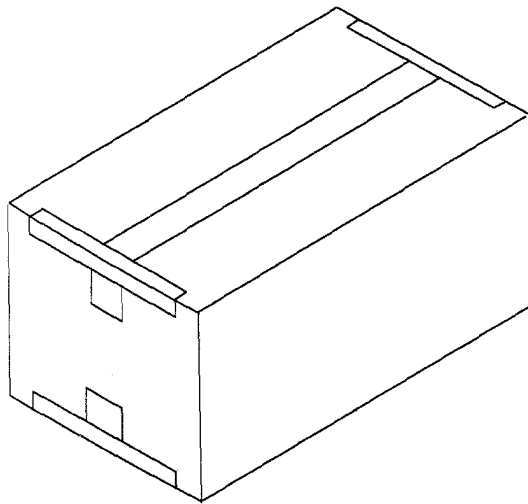
| Inside Width of Box in ^A | Number of Fasteners at Each End of Box, by Method | | |
|-------------------------------------|---|----------------------|-----------------------|
| | 2D1, Commercial, Fig 5 | 2S2, Rule 41, Fig. 6 | 2D3 Government, Fig 7 |
| 6 | 2 | 2 | 6 |
| 7 | 2 | 4 | 6 |
| 9 | 4 | 6 | 6 |
| 10 | 4 | 6 | 8 |
| 11 | 4 | 6 | 8 |
| 12 | 4 | 8 | 10 |
| 14 | 6 | 10 | 12 |
| 16 | 6 | 10 | 14 |
| 17 | 6 | 12 | 14 |
| 18 | 6 | 12 | 16 |
| 19 | 8 | 14 | 16 |
| 20 | 8 | 14 | 18 |
| 22 | 8 | 16 | 20 |
| 24 | 10 | 16 | 22 |

^A One inch = 25.4 mm

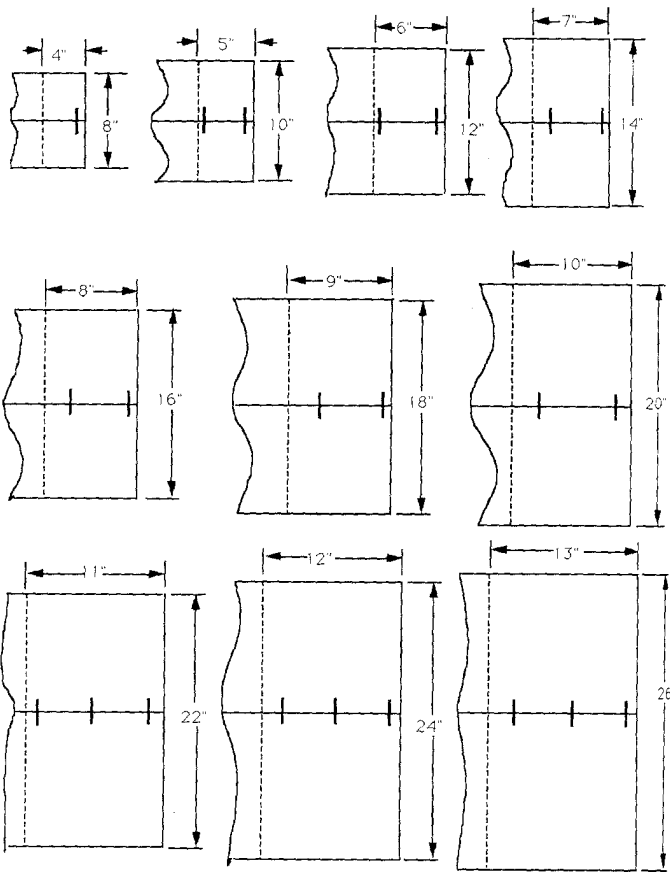
Number of Wide Crown Staples or Stitches for Regular Slotted Containers

| Inside Width of Box in ^A | Number of Fasteners at Each End of Box, by Method | | |
|-------------------------------------|---|-------------------------|-------------------------|
| | 2D4, Commercial, Fig 8 | 2D5, Old Rule 41, Fig 9 | 2D6, Government, Fig 10 |
| 8 | 1 | 1 | 4 |
| 10 | 2 | 2 | 5 |
| 12 | 2 | 2 | 6 |
| 14 | 2 | 2 | 8 |
| 16 | 2 | 4 | 9 |
| 18 | 2 | 4 | 10 |
| 20 | 2 | 4 | 11 |
| 22 | 3 | 5 | 12 |
| 24 | 3 | 5 | 14 |
| 26 | 3 | 5 | 15 |

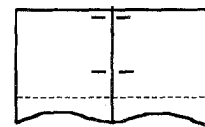
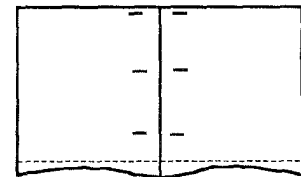
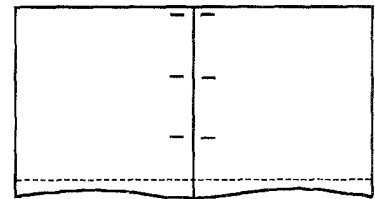
^A One inch = 25.4 mm



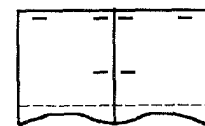
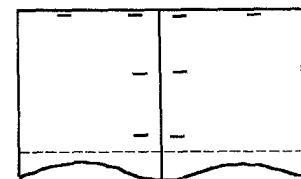
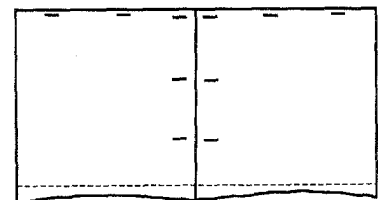
Example of Closure Method 2B7



Example of Closure Method 2D4



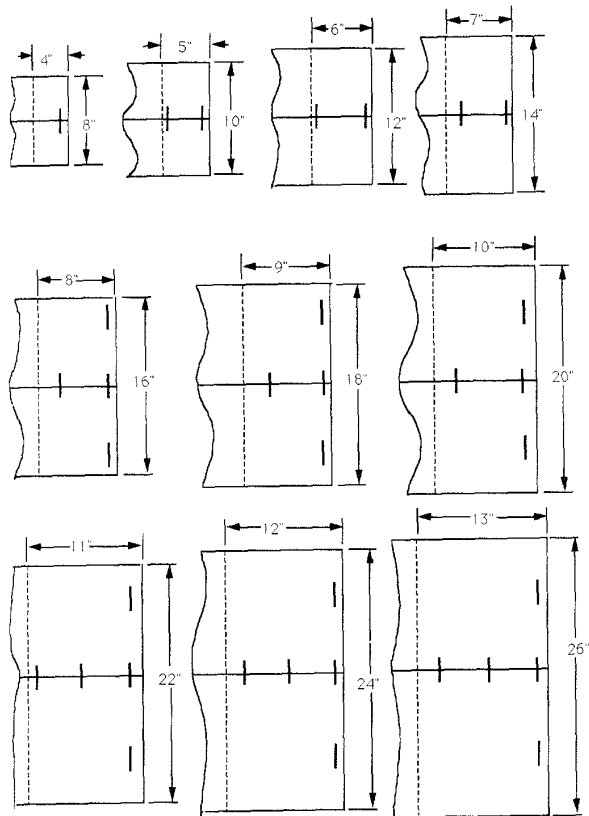
Example of Closure Method 2D1



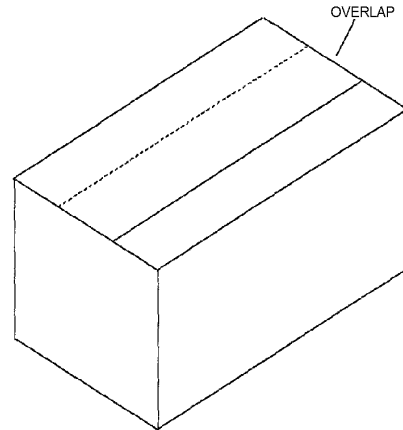
Example of Closure Method 2D2

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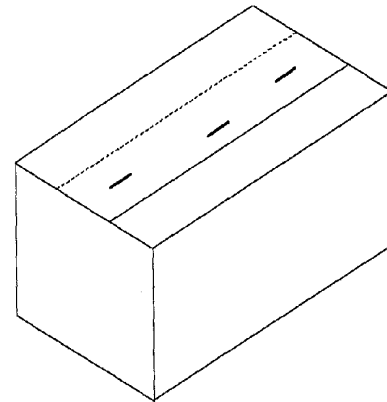
Figure 2-15. Closure methods of fiberboard boxes.



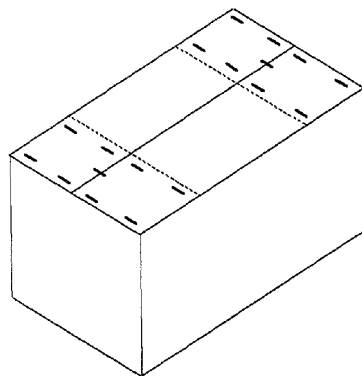
Example of Closure Method 2D5



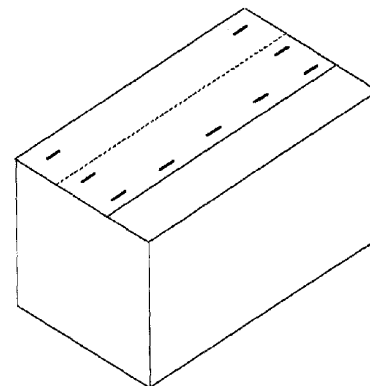
Example of Closure Method 3A1 and 3A2



Example of Closure Method 3D1



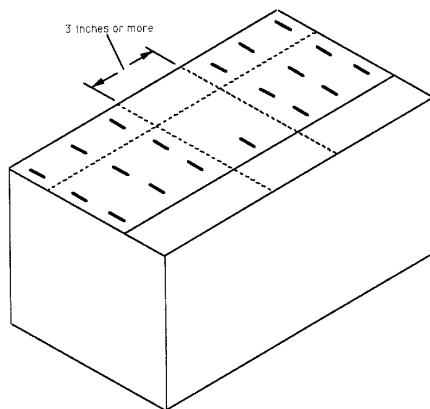
Example of Closure Method 2D6



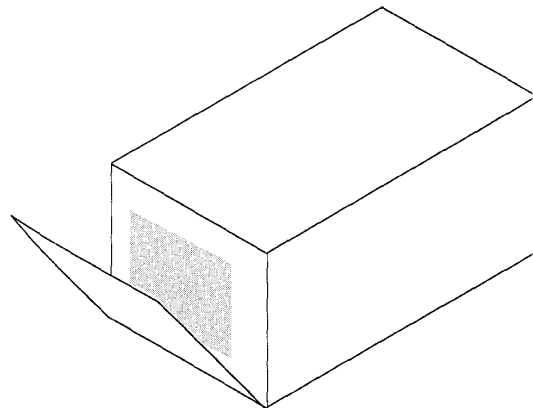
Example of Closure Methods 3D2, 3D3, and 3D4

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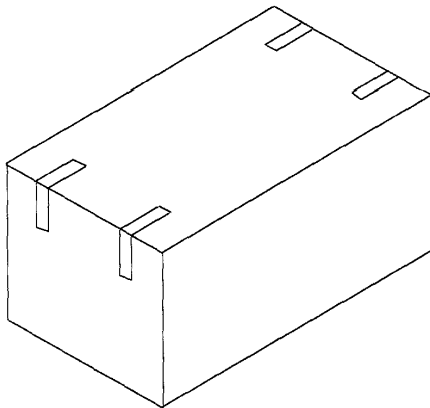
Figure 2-16. Closure methods for fiberboard boxes.



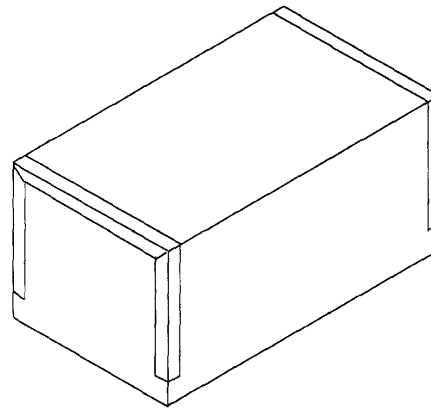
Example of Closure Method 3D5



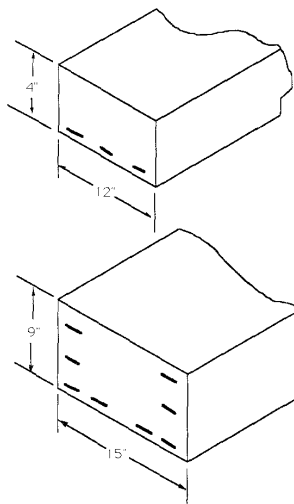
Example of Closure Methods 4A1 and 4A2



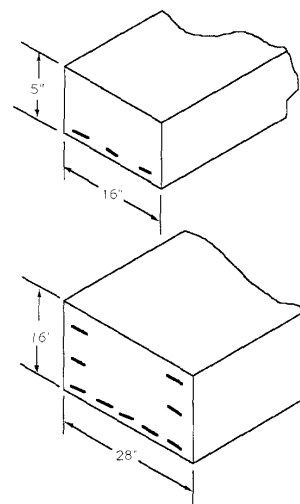
Example of Closure Methods 4B3, 4B4, 4B5, and 4C2



Example of Closure Methods 4B1, 4B2, and 4C1



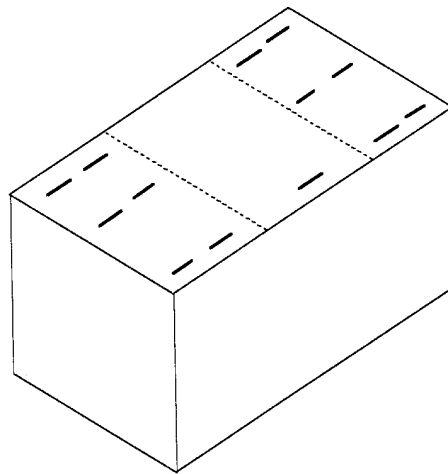
Example of Closure Methods 4D1 and 4D2



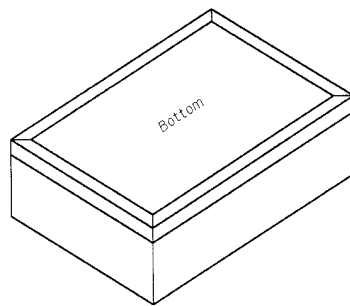
Example of Closure Methods 4D3 and 4D4

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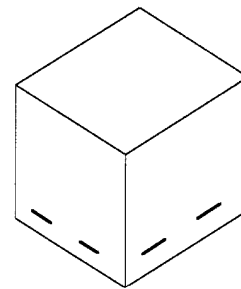
Figure 2-17. Closure methods for fiberboard boxes.



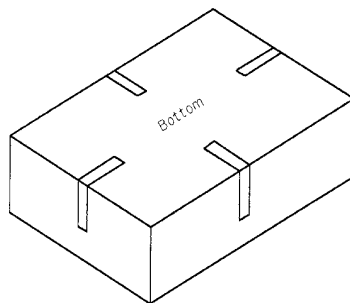
Example of Closure Method 4D5



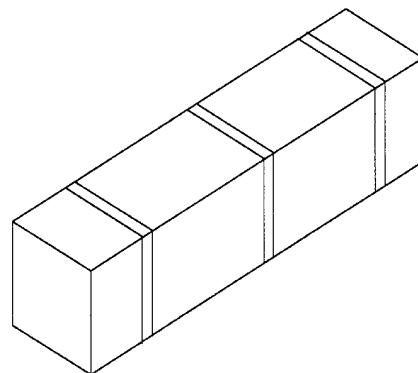
Example of Closure Methods 5A1, 5A2, and 5B1



Example of Closure Methods 5C1 and 5C2



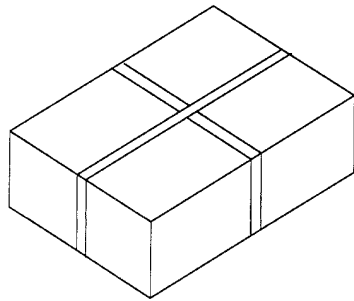
Example of Closure Methods 5A3, 5A4, 5A5, and 5B2



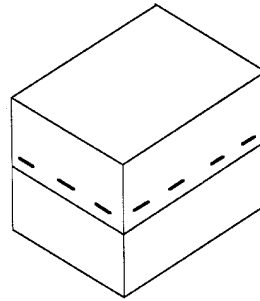
Example of Closure Method 6D2 and Reinforcement Methods 2A and 2B

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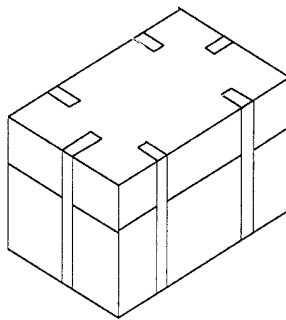
Figure 2-18. Closure methods of fiberboard boxes.



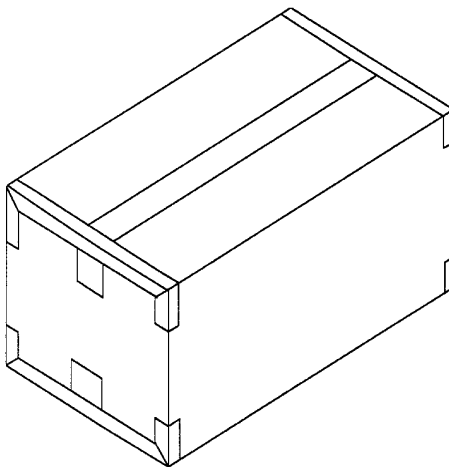
Example of Closure Method 6D3



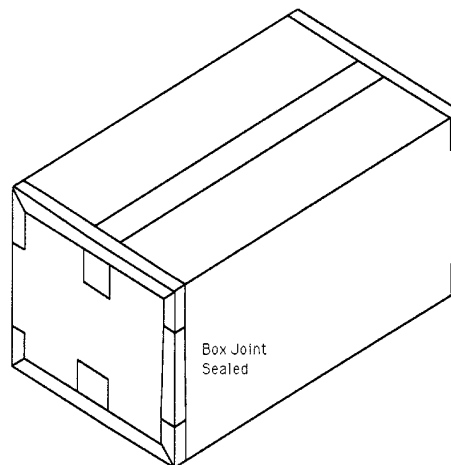
Example of Closure Methods 6C1 and 6C2



Example of Closure Methods 6B1, 6A2, and 6A1



Example of Sealing Method A



Example of Sealing Methods B, C, and D

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Figure 2-19. Closure methods of fiberboard boxes.

Table 2-8. Metallic and nonmetallic strapping requirements. IAW ASTM D 4675.

| Gross weight of container and contents | ASTM D3953/ ASTM D4675 | ASTM D3950 Nonmetallic B | | ASTM D3853 Zinc Galvanized | |
|--|--|--|-----------------------------|----------------------------|---------|
| (Pounds) | Type I | Type II | Type III | Grade 1 | Grade 2 |
| Up to 35 | 1/4 x 0.015 5/16 x 0.012 5/8 x 0.010 | 3/8 x 0.015 3/8 x 0.018 or 1/4 x 0.025 or 0.027 | 7/16 x 0.017 1/2 x 0.015 | 16-1/2 | 16-1/2 |
| Over 35 to 70, incl. | 3/8 x 0.015 A/ | 3/8 x 0.015 3/8 x 0.024 or 1/4 x 0.025 or 0.027 or 7/16 x 0.025 | 7/16 x 0.017 1/2 x 0.015 | 16 | 15 |
| Over 70 to 110, incl. | 3/8 x 0.020 1/2 x 0.015 | 1/2 x 0.015 3/8 x 0.020 7/16 x 0.025 or 1/2 x 0.022 | 1/2 x 0.015 7/16 x 0.017 | 14 | 13 |
| Over 110 to 225 incl. | 1/2 x 0.020 5/8 x 0.015 | 1/2 x 0.020 5/8 x 0.015 7/16 x 0.025 | 7/16 x 0.023 1/2 x 0.020 | 13 | |

A Size 1/4 by 0.015 in strap may be used for Type 1 loads and FTC boxes of frozen foods.

B/ Other type and sizes may be applicable.

Table 2-9. Required number of reinforcing bands

| Direction of bands ¹ | | | | | |
|---------------------------------|------------------------------------|-----------------------|------------------------------------|-------------------------|------------------------------------|
| Lengthwise | | Girthwise | | Horizontal ² | |
| Outside width of box | Number of bands (min) ³ | Outside length of box | Number of bands (min) ³ | Outside depth of box | Number of bands (min) ³ |
| <i>Inches</i> | | <i>Inches</i> | | <i>Inches</i> | |
| Up to 9..... | None | Up to 20 | 1 | Up to 18 | None |
| Over 9 to 18..... | 1 | 20 to 30, incl. | 2 | 18 to 30, incl. | 1 |
| Over 18 to 30..... | 2 | Over 30 to 48 | 3 | Over 30 to 48 | 2 |
| Over 30 to 48..... | 3 | Over 48 to 60 | 4 | | |
| Over 48..... | | Over 60 ⁴ | | Over 48 ⁴ | |

¹ Lengthwise--Encircling top, bottom, and ends, Girthwise--Encircling top, bottom, and sides. Horizontal--Encircling sides and ends.

Note that the location of the openings determines the designation of the panels, rather than normal storage position.

² Horizontal bands are only occasionally required. where contents exert severe pressure on vertical score lines, they should be used.

³ Full telescope-style boxes, having corners not otherwise sealed to bodies, will usually require use of one or more additional bands, both lengthwise and girthwise when dimensions approach the upper range of the size brackets listed in above table. Additional bands, when required, will be specified by the procuring agency.

⁴ As directed by the procuring agency.

NOTE

Reinforcement may be omitted from class weather-resistant boxes containing non-perishable subsistence items and clothing which are to be palletized or containerized. An exception to this is nonperishable subsistence materiel consigned to the Naval Supply Center at Norfolk and Oakland for subsequent transfer at sea.

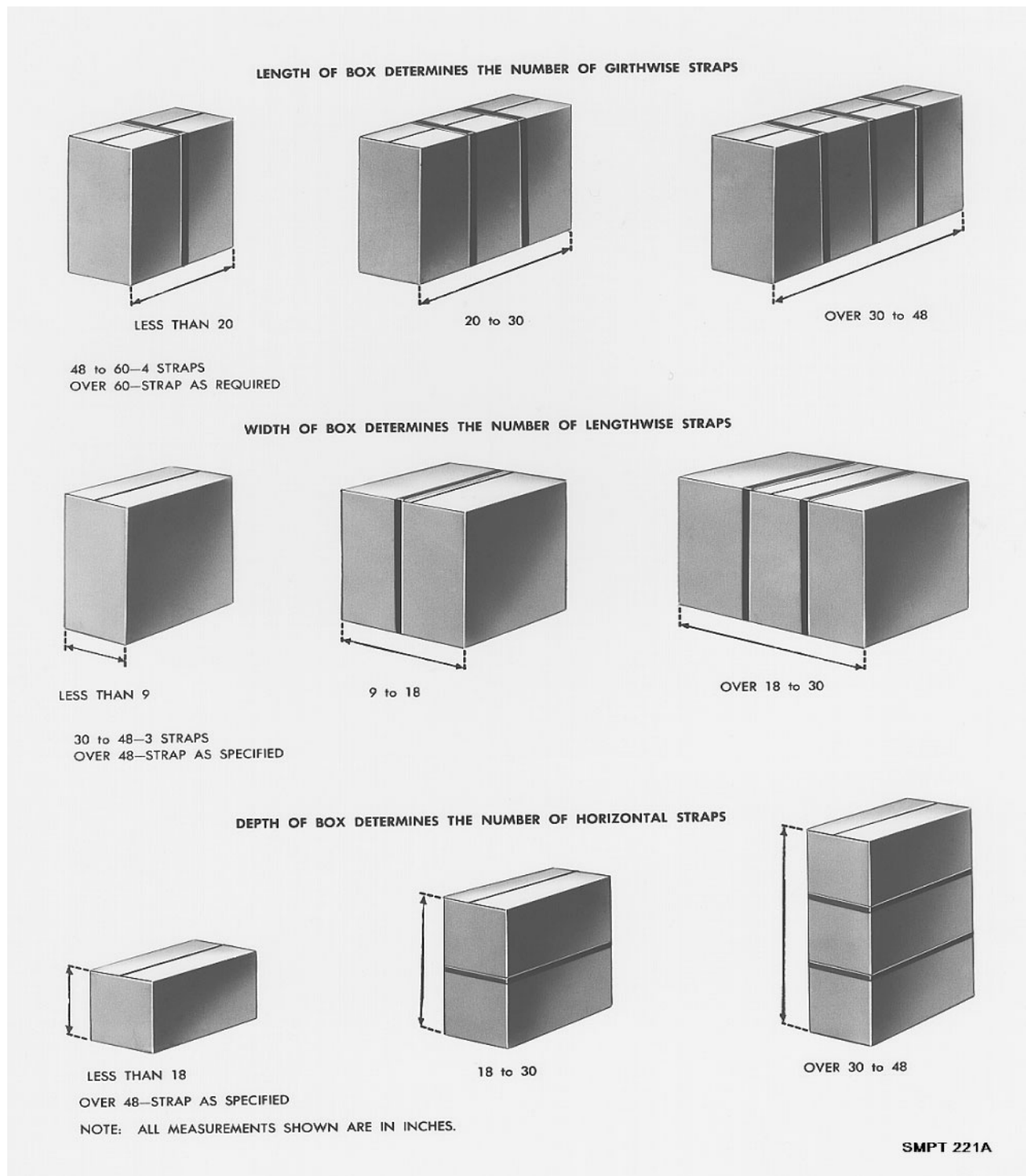


Figure 2-20. Strapping of fiberboard boxes.

Reuse and Conservation of Fiberboard Boxes

It is important that attention be given to the reuse and conservation of fiberboard boxes. This must be looked upon from an economical standpoint. If care is used in opening incoming fiberboard boxes, some of them may be reused as interior intermediate containers, but never as exterior shipping containers, with the exception of good V-board boxes. The condition of the box is a big factor in its reuse. No box that has been cut, torn, pierced, or damaged by water or moisture should be reused. If used, V-board boxes are included in this category, they may be reused for domestic shipments. Used boxes shall have all old markings pertaining to previous shipments obliterated before reuse as interior or exterior containers. If the whole boxes cannot be reused, consideration should be given to the use of clean, sound fiberboard as material for one of the following applications:

Fabrication of blocking and bracing. Blocking and bracing are used to prevent movement of the item within the container, contact of items among themselves (when more than one is packed in a shipping container), or contact of an item with the faces of the container.

Fabrication of die-cuts, cells, trays, pads, etc., for cushioning purposes.
Triple-wall Corrugated Fiberboard Boxes (ASTM D 5168)

TRIPLE-WALL CORRUGATED FIBERBOARD BOXES (ASTM D 5168)

DESCRIPTION AND CHARACTERISTICS

A triple-wall corrugated fiberboard box is a container made of triple-wall corrugated fiberboard in accordance with ASTM D 5168. Triple-wall corrugated fiberboard consists of three corrugated sheets laminated to four flat facings (fig. 2-3) resulting in a thick, relatively sturdy structural material. Boxes made of this material have the following characteristics:

- They are especially suited for difficult, heavy loads that require exceptionally large containers.
- They are extremely resistant to sudden forces such as those encountered when the box is dropped.
- They have a high resistance to compression and can sustain heavy loads for long periods of time.
- They are lighter in weight and smaller in cube than wooden containers made for the same items.
- They have certain inherent cushioning characteristics due to the corrugated stock from which they are made.

The fire-retardant requirements of boxes are intended to reduce losses due to fire destruction.

Classes and Styles. Triple-wall, corrugated fiberboard boxes are furnished in the following classes, styles, and types of ends:

Nonweather resistant.
Weather resistant.
Fire-retardant.

Style A - One-piece fiberboard, five-panel, with one of four types of ends, and with ends inserted in box body (fig 2-21).

Style B - One-piece fiberboard, five-panel, with one of four types of ends, and with ends inserted in box body overlapped on box ends (fig 2-21).

Style C - Two-piece fiberboard, three-panel, with one of four types of ends, and with ends inserted in box body overlapped on the box ends (fig 2-21).

Style D - Two-piece fiberboard, three-panel, with one of four types of ends, and with ends inserted with outside edges of the box body overlapped on box ends (fig 2-22).

Style E - A regular slotted fiberboard box conforming to style RSC ASTM D 5118. The body (manufacturer's) joint should be 2 inches wide, crushed, and stapled on a slant not more than 1 inch apart (fig 2-22). The corrugations of that portion of the side panel in which the body joints overlap shall also be crushed. Style E boxes may also be made with a 1 1/2-inch crushed overlap on the top and bottom panel of the box. This is called an alternate style E box.

Style F - A full telescopic fiberboard box, consisting of a body and a cover each of one-piece slotted and scored triple-wall fiberboard. The inside depth of the cover shall be the overall depth of the body (fig 2-22).

Style G - Half regular slotted box with short top flaps and cover. Style G box is similar to style F, except that all the top flaps are 4 inches long and are crushed-rolled 1 1/2-inches at the edges. A cover, at least 6 inches deep, forms the top of the container. The cover may be constructed so that the end and side flanges form a butt joint at each of the four corners (fig 2-23), or it may be made with end or side flaps which are stapled to the adjacent flange of the top.

Wood Ends

There are four types of wood or wood-cleated panel ends that can be used with styles A, B, C, and D triple-wall, corrugated fiberboard boxes. The wood used to fabricate the ends must conform to wood groups I and II as set forth in PPP-B-621. The ends are of the following designs (fig 2-24).

Number 1 end--A single piece of nominal 2-inch lumber.

Number 2 end--Two thicknesses of nominal 1-inch lumber with the grain at right angles, the two thicknesses securely joined by clinched nails, and no piece less than 2 1/2 inches in width.

Number 3 end--Nominal 1-inch material with a nominal 1-inch thick cleat minimum width of 2 1/4 inches, securely joined by clinched nailing.

Number 4 end--Cleated panel ends consisting of two sets of overlapped cleats with a panel of triple-wall corrugated fiberboard. The cleats shall be nominal 1-inch thick, 2 1/4 inches wide, and shall be assembled with clinched nailing. The fiberboard shall be fastened to the inside of the cleats with either nails or staples.

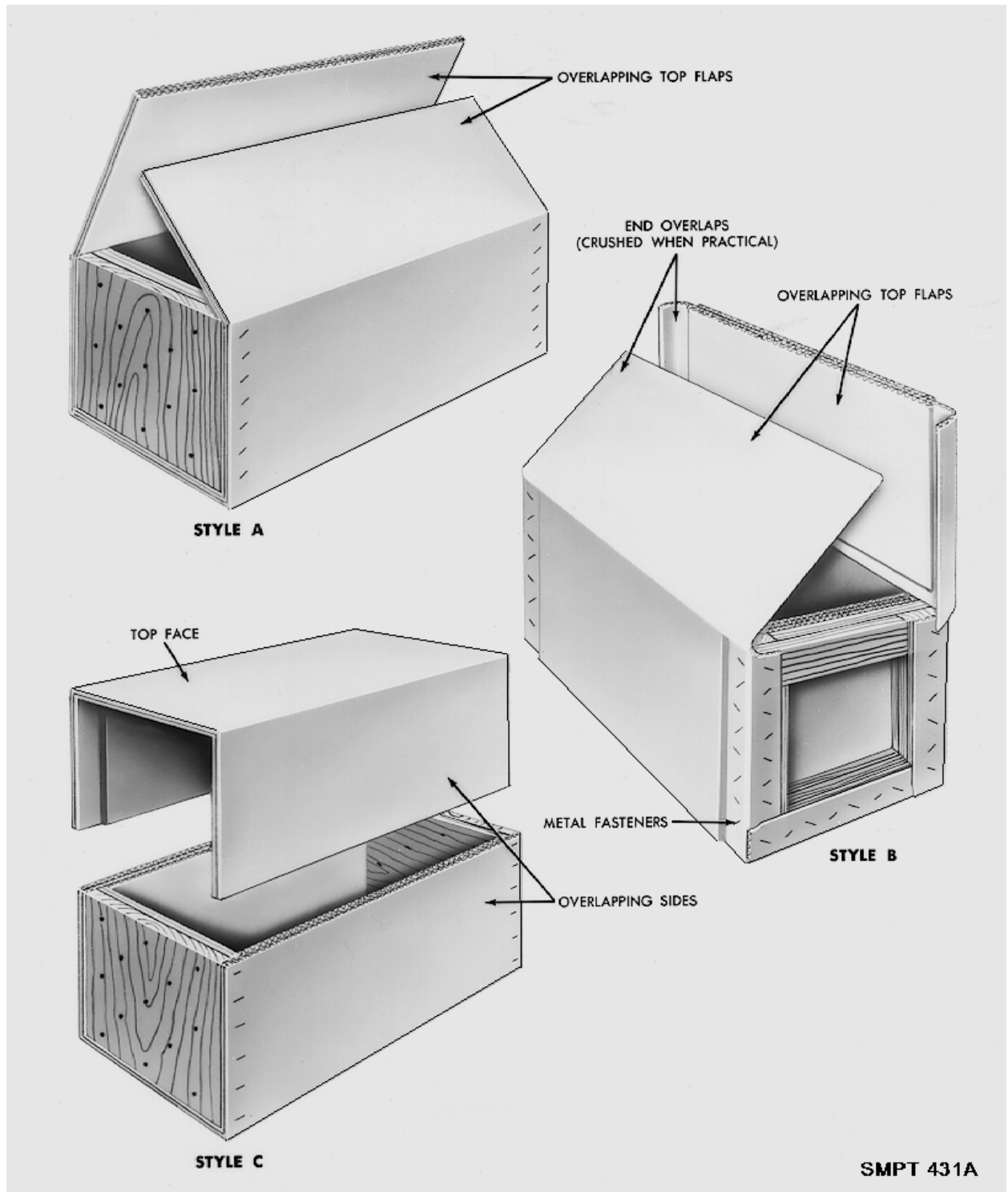
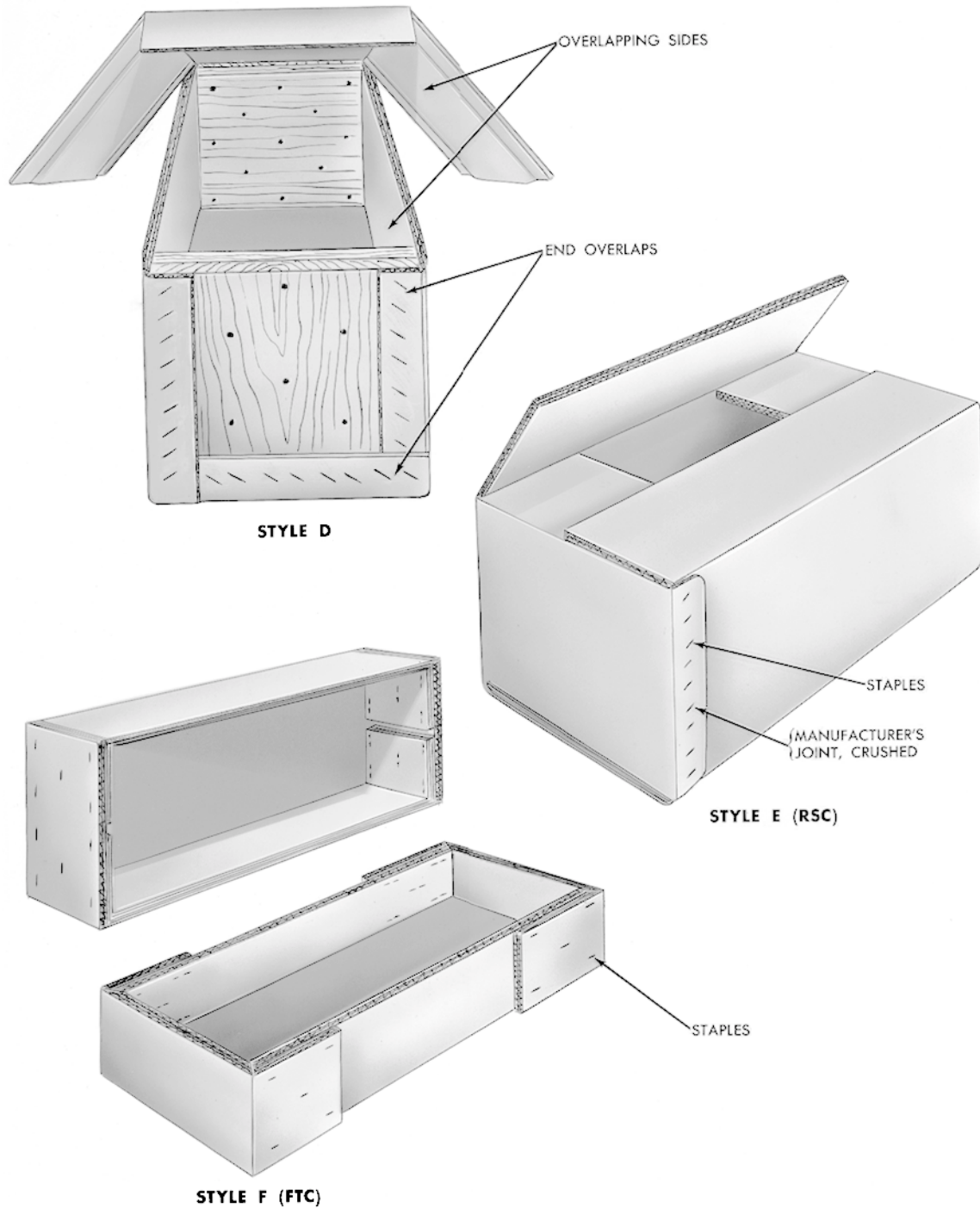


Figure 2-21. Styles A, B and C triple-wall corrugated fiberboard boxes.



STYLES D, E, AND F TRIPLE WALL BOXES

SMPT 432A

Figure 2-22. Styles D, E, and F, triple-wall corrugated fiberboard boxes.

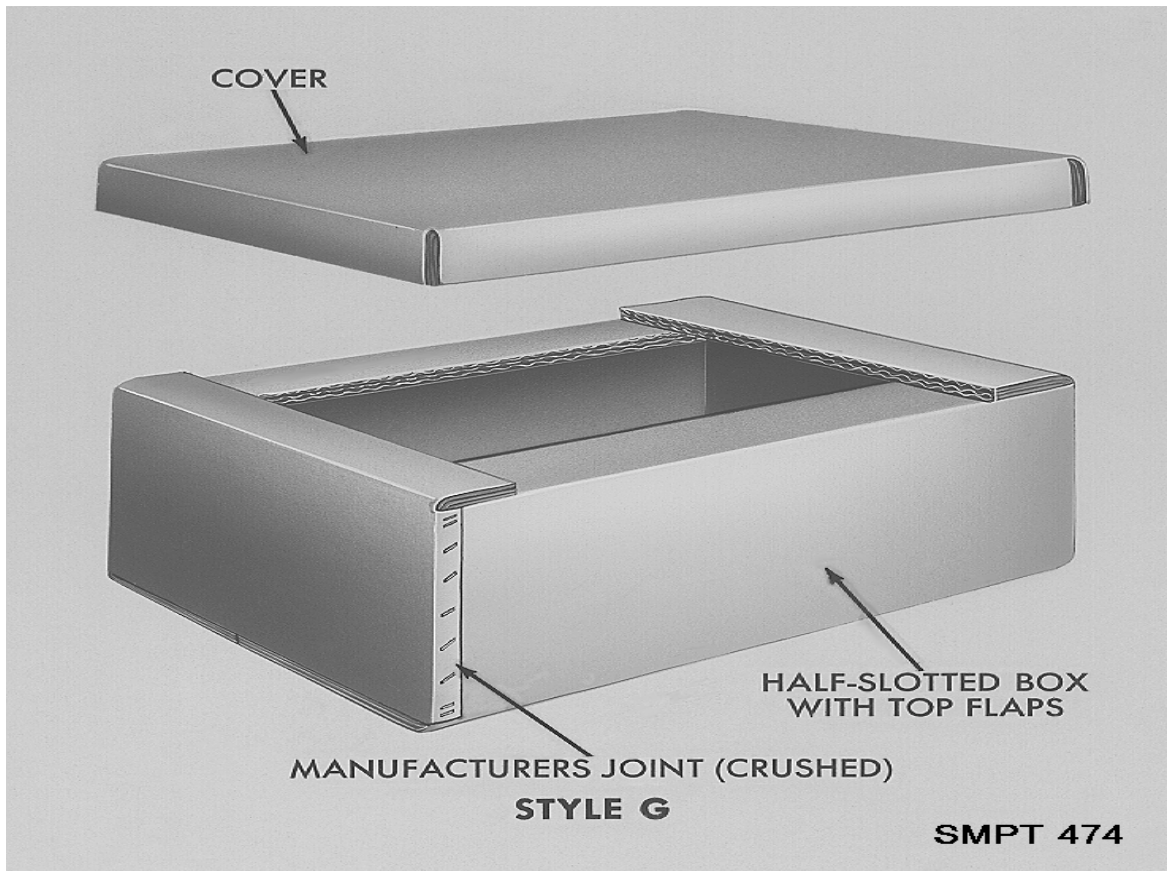


Figure 2-23. Style G triple-wall corrugated fiberboard box.

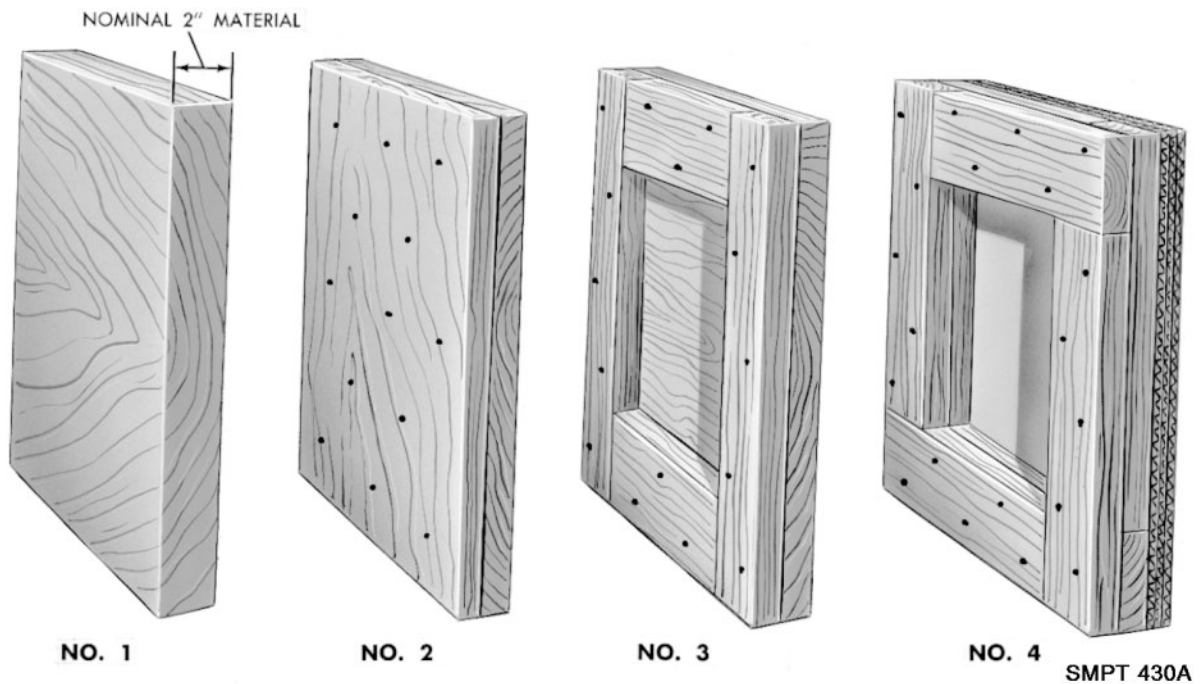


Figure 2-24. Types of ends to be used with styles A through D triple-wall corrugated fiberboard boxes.

Limitations

Maximum weight and size limitations for triple-wall corrugated fiberboard boxes are not given in ASTM D 5168. When triple-wall, corrugated fiberboard boxes are to be used for commodities covered in Rule 41 of the Uniform Freight Classification and item 222 of the National Motor Freight Classification, the sum of the inside length, width, and depth shall not exceed 125 inches. Containers exceeding these limitations must be made under a special package permit.

Sealing

When sealing against the entry of water or dust is required, all seams and joints of the boxes shall be covered with minimum 2-inch tape conforming to ASTM D 5486, Type V. Closure of slotted boxes is frequently done prior to sealing.

Closure

The kinds of closure for triple-wall, corrugated fiberboard boxes will depend on the style of box to be used, and may be made by means of nails, staples, steel straps, filament-reinforced tape, or a combination of these materials. When nails are used for closure or for fastening blocking and bracing members to the interior of the boxes, it is recommended that each nail should pass through an oversize washer, piece of banding, or clips designed to prevent pulling of the nail heads through the triple-wall material. Whenever reinforcing needed, DOD personnel may use ASTM D 3950, ASTM D 3953, or ASTM D 4675.

Closure of style A boxes

This style may be closed with zinc-coated or copper-washed staples, with divergent points and minimum dimensions of 14 gauge wire, 3/4 inch crown, and 1 1/4 inch legs; with flat, Type I, Class A or B, 5/8 inch wide and 0.018 inch thick steel straps conforming to ASTM D 3953 or with nonmetal strapping in accordance with ASTM D 3950, Type I or II (when Type I is used it shall be Grade B) with a nominal width of 5/8 inch; or with pressure-sensitive, filament-reinforced tape meeting the requirements of ASTM D 5330, Type III, 1/2-inch wide, except for Styles E and F, which shall be 1 inch wide. On weather-resistant boxes, the ASTM D 5330 tape shall be Type IV, 3/4 inch wide, except for Styles E and F, which shall be 1 inch wide.

Using nails for closure of style A boxes

When nails or staples are used, they shall be spaced not more than 2 inches apart and staggered as permitted by the thickness of the ends of the box. The nails or staples shall extend through each thickness of fiberboard and into the wood ends. If the box is 24 inches long, a strip of filament-reinforced tape shall be placed at the center of the outside top flap so as to extend onto the top flap 5 inches and onto the side panel 5 inches. For length greater than 24 inches, one such strip will be added for each additional 18 inch increment of length greater than 24 inches. The total number of strips will be spaced evenly (fig 2-25).

Using straps for closure of style A boxes

When steel or nonmetal straps are used, one band will be placed at each end of the box to encircle the top, sides, and bottom of the box. The straps will be placed not more than 3 inches in from the ends to bear evenly on the wood ends. If the box is 24 inches long, a strap will be added at the center.

Filament-reinforced tape may be used in lieu of this additional strap. For lengths greater than 24 inches, one such strap will be added for each additional 18 inches of length and placed so that they are evenly spaced (fig 2-25).

Using Tape For Closure Of Style A Boxes

When filament-reinforced tape is used, a 10-inch strip will be placed 2 inches in from each end of the box. For boxes 24 inches long or over, additional strip requirements are the same as for steel strapping. All the tape strips will be applied perpendicular to the joint formed by the top flap and the side wall of the box. They will be centered over the joint and extend 5 inches onto the top flap and 5 inches on the side wall (fig 2-25).

Closure Of Style B Boxes

Style B boxes may be closed with nails or staples in the same manner as Style A boxes; but, in addition, a staggered row of nails or staples, spaced not more than 2 inches apart, must be driven through the overlap portion of the top flap into the face of the wood ends. When using steel straps or filament-reinforced tape for closure, the same requirements as given for Style A boxes also apply to Style B (fig 2-25).

Closure of Style C Boxes

This style of box will be closed along the top and sides by means of nails, staples, or steel straps as specified for Style A boxes, except when using nails or staples they will be spaced not more than 2 inches apart and staggered and driven through the top one-half of the box into the wooden ends along the two end edges of each side panel and both end edges of the top panel (fig 2-26).

Closure of Style D Boxes

This style of box shall be closed along the top and sides by means of nails, staples, or steel straps as specified for style A. In addition, a staggered row of nails or staples shall be driven through the overlapping top flaps into the face of the wooden ends. For boxes 24 inches long and longer, strips of tape will be applied as for style A box (fig 2-26).

Closure of Style E Boxes

Style E boxes may be closed by the use of staples, steel or nonmetallic strapping, or with tape.

Closure with Staples

Staples will not be used for boxes fabricated with class weather-resistant fiberboard. Staples are placed not more than 1 1/2 inches, or less than 1 inch, from the free edge of the flap. Spacing around the edge of each flap is not more than 5 inches, center-to-center of the staples. Additional staples are so spaced within the boundaries outlined by the edge staples so that no area will have a diameter greater than 4 inches without a staple, with a minimum number of eight staples in each flap. Staples are flat wire, 0.050 inch thick, 0.085 inch wide, with a 1 1/4-inch crown (fig 2-27).

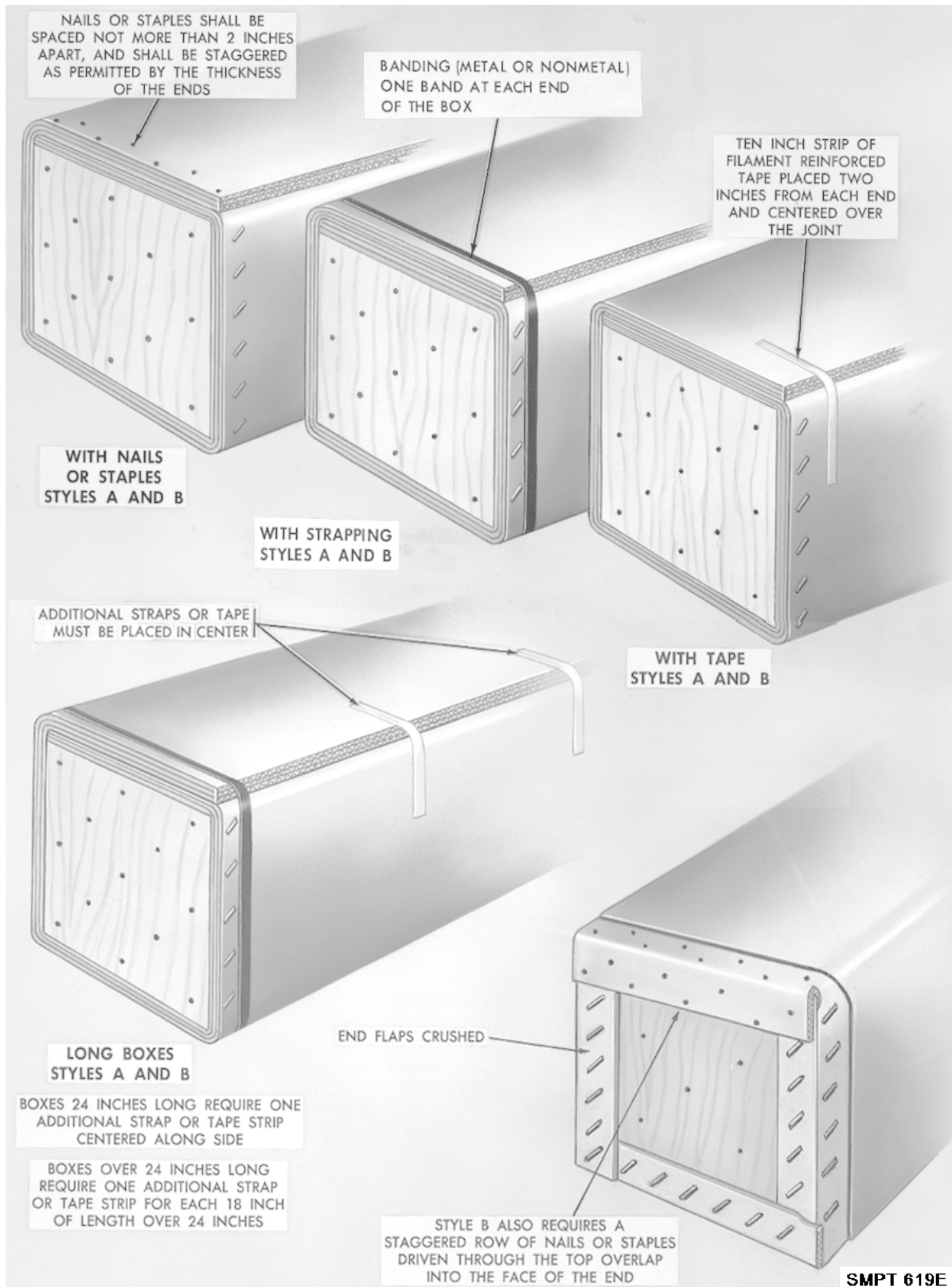


Figure 2-25. Closure of styles A and B, triple-wall corrugated fiberboard boxes.

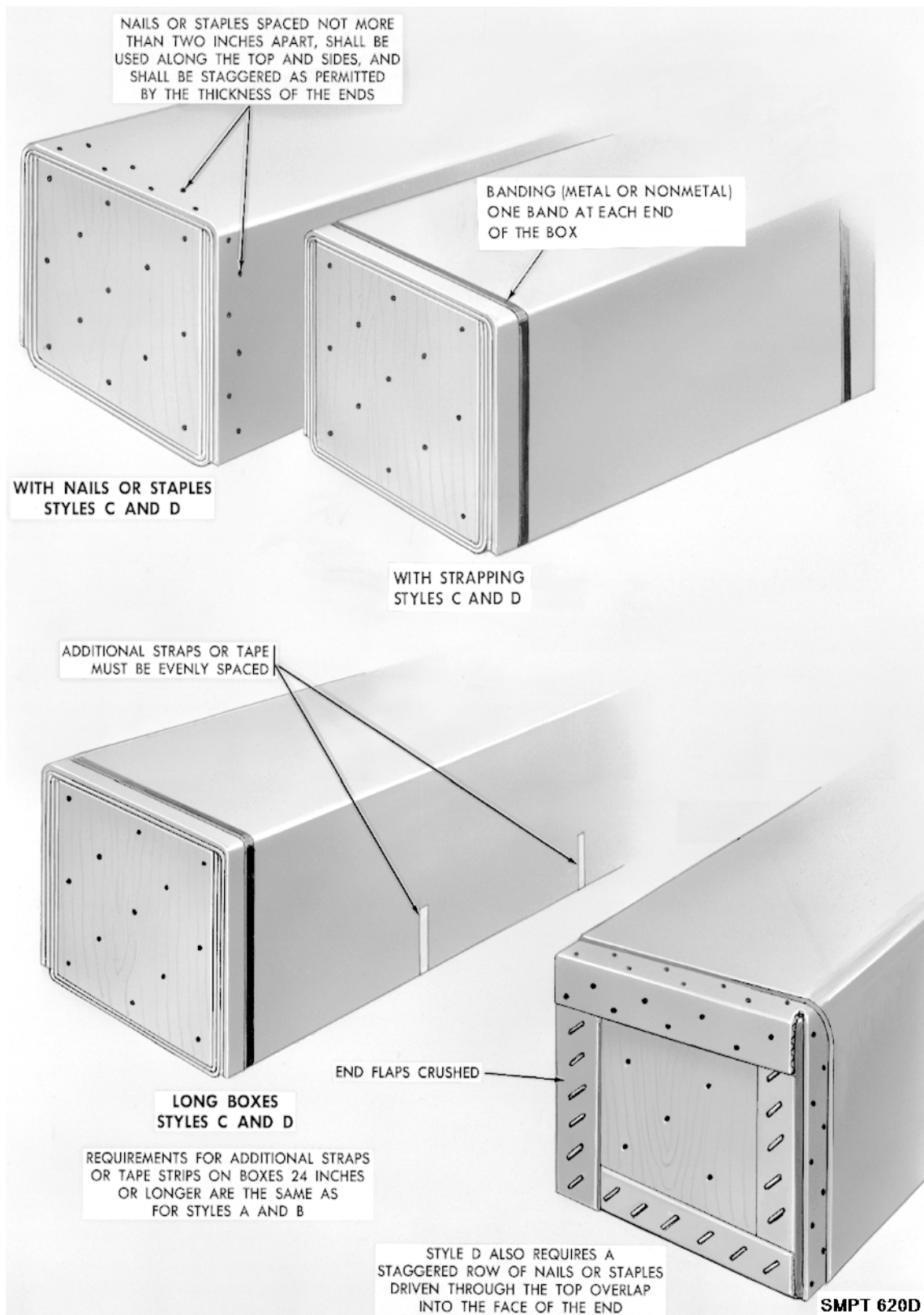


Figure 2-26. Closure of styles C and D, triple-wall corrugated fiberboard boxes.

Closure With Metal or Nonmetallic Strapping

The requirements for closure with strapping is the same as for style A boxes, except that a lengthwise strap may be applied to hold the girthwise strap flat (fig 2-27).

Closure With Tape

A 12-inch strip is applied to each end of the two top and bottom flaps so that 6 inches of each strip is attached to the flap and 6 inches of each strip is attached the end panel. The strips are located adjacent to the inner length edge of the flaps, approximately 2 inches from this edge. The use of additional strips will be specified for style A boxes.

Closure of Style F Boxes

This style may be closed with steel or nonmetallic straps or filament-reinforced tape. When straps are used, they will be applied as described for style E boxes. When tape is used, one strip will be used on each side and each end. The strips will be not less than 12 inches long and will be applied at the center of the side and end panels and extend to the bottom of the box. When the length of the box is 24 inches, an additional strip will be added to each side and the two will be evenly spaced. Additional strips as required for length will be added to the ends when the box is 24 inches or greater in width (fig 2-28).

Closure of Style G Boxes

When this box is used in conjunction with a pallet, closure and sealing will be as specified by the procuring activity. Without a pallet, an additional strip will be added to each side and the box will be closed with straps. One strap will be centrally located around the top, ends, and bottom. Two straps will be applied around the top, sides, and bottom, at a distance from the ends equal to three-fourths the length of the inner flaps. If the distance between the straps exceeds 24 inches, additional straps will be spaced not more than 24 inches apart (fig 2-29).

Paperboard Boxes

Paperboard boxes are mainly used for interior packing. They are available in various types, styles, and sizes, and must conform to requirements of PPP-B-566, and PPP-B-676. In many instances, depending upon the item, a paperboard box may be used in packing when utilizing parcel post. For further details on paperboard boxes, see FM 38-700.

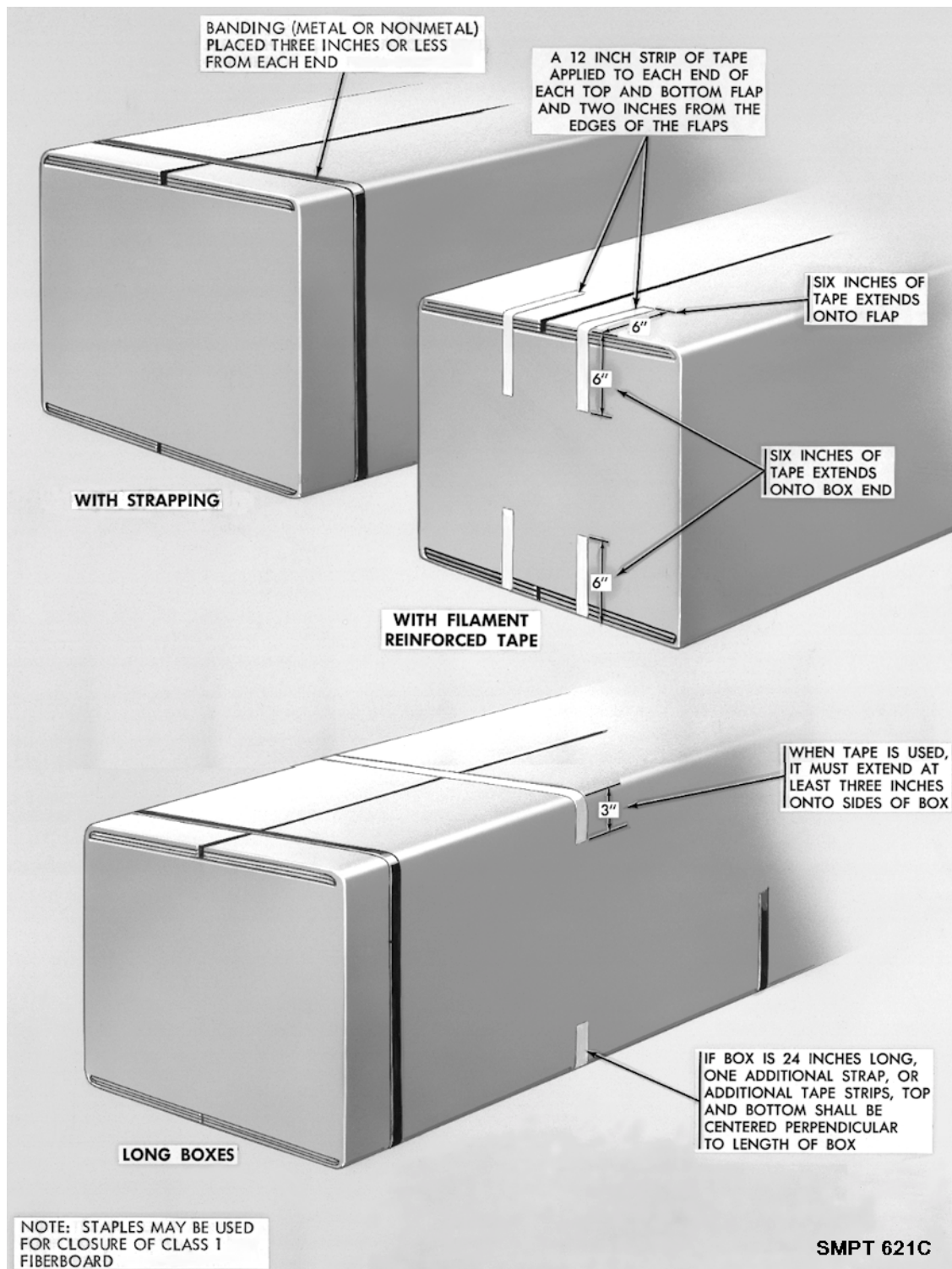


Figure 2-27. Closure of style E, triple-wall fiberboard box.

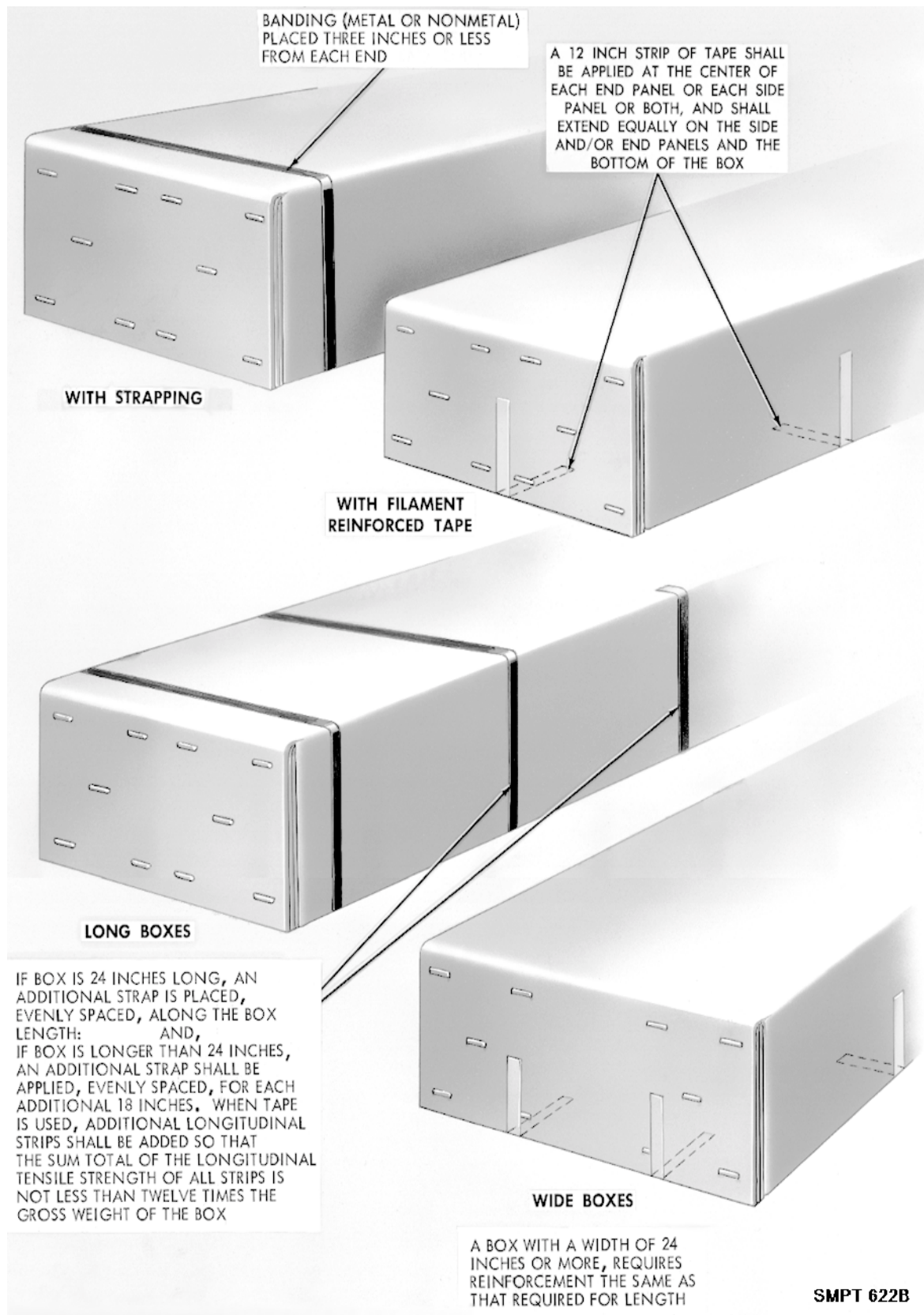


Figure 2-28. Closure of style F, triple-wall fiberboard box.

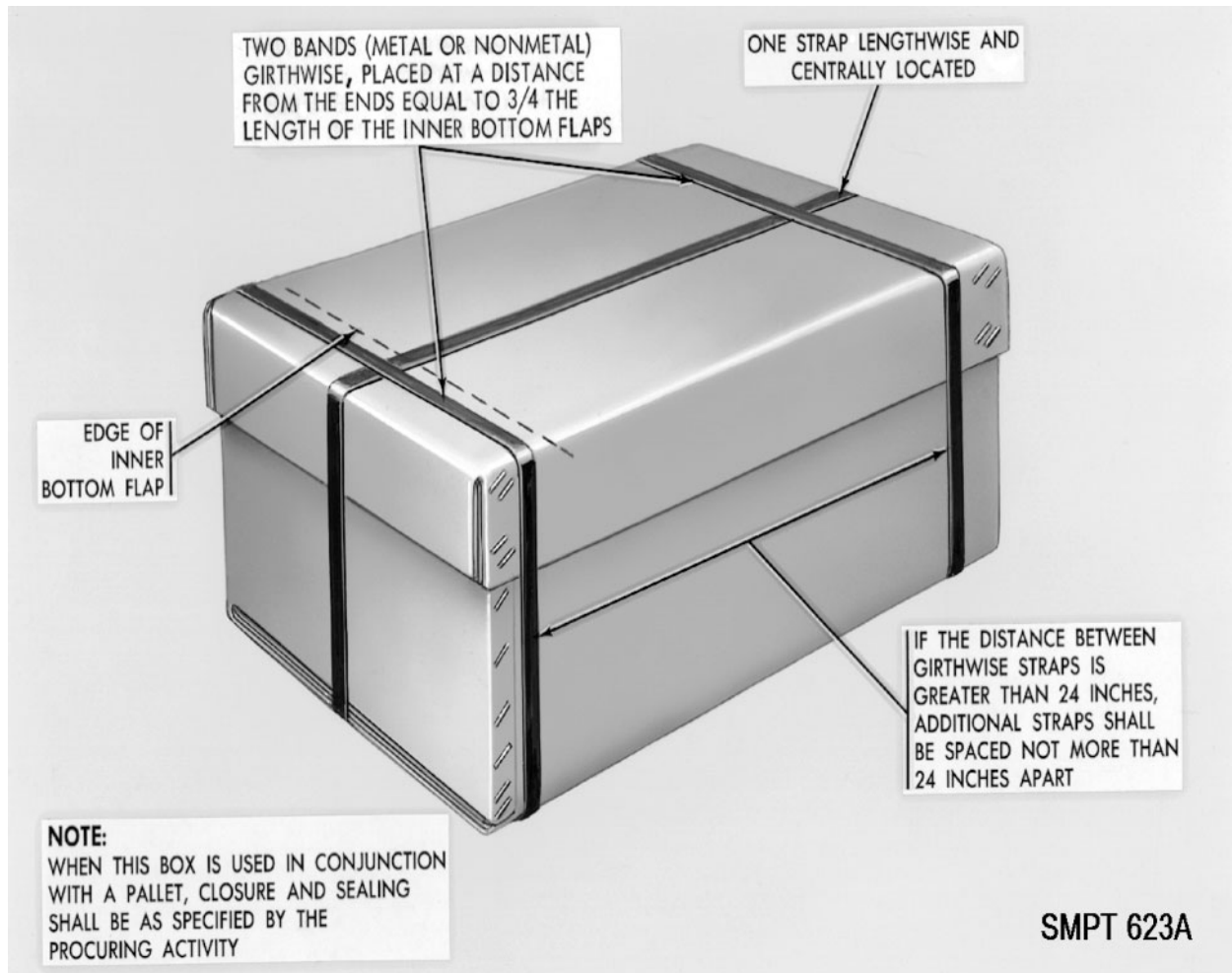


Figure 2-29. Closure of G style triple-wall fiberboard box.

CHAPTER 3

WOODEN CONTAINERS AND PALLETS

CONTAINER MATERIALS

WOOD AS A CONTAINER MATERIAL

Wood is particularly valuable as a container material because of its high strength-weight ratio which compares favorably with mild steel. Tests and experience have shown that the strength of a wooden container depends largely upon the type of wood used in its construction. The durability of wood and its ability to withstand shock and impact stresses are important properties in the selection of wood for containers. Military Handbook MIL-HDBK-7, "Lumber and Allied Products", provides a ready source of information on wood products normally procured in considerable quantity for Department of Defense installations. This handbook is not intended for reference in purchase specifications or other contractual documents. However, it will assist materially with installation requisitioning, receiving, inspection, storage, and handling of container wood materials. Also see ASTM D 6436, Quality of Wood Members for Containers and Pallets.

Wood Groups

All woods fall into two general categories: Either softwoods, which come from coniferous or needle-bearing trees; or hardwoods, which come from broad-leaved trees. For purposes of container construction, wood is divided into four groups based on nail holding power, tendency to split, comparative strength as a beam, and shock resisting capacity (fig 3-1). Over 90 percent of all wooden containers are made from Group I and II woods however, the materials given in Section 3 of the applicable container specification must be used. When a wood group is specified in the contract, any species in that group may be selected.

Group I includes the softer woods such as white fir, ponderosa pine, yellow poplar, cottonwood, cedar, and others. These woods are relatively free from splitting when being nailed, have a moderate nail-holding power, moderate strength as a beam, and moderate shock resisting capacity.

Group II includes the harder soft woods such as Douglas fir, southern pine, hemlock, and larch. They have greater nail-holding power than the Group I woods, as well as greater strength and shock resisting capacity. Group II woods are more inclined to split, the grain often deflects nails and causes them to run out at the side of the piece.

Group III includes the medium density hardwoods. Ash, elm, and cherry are examples. These are similar to Group II woods in nail-holding power and strength as a beam, but have less tendency to split and shatter under impact.

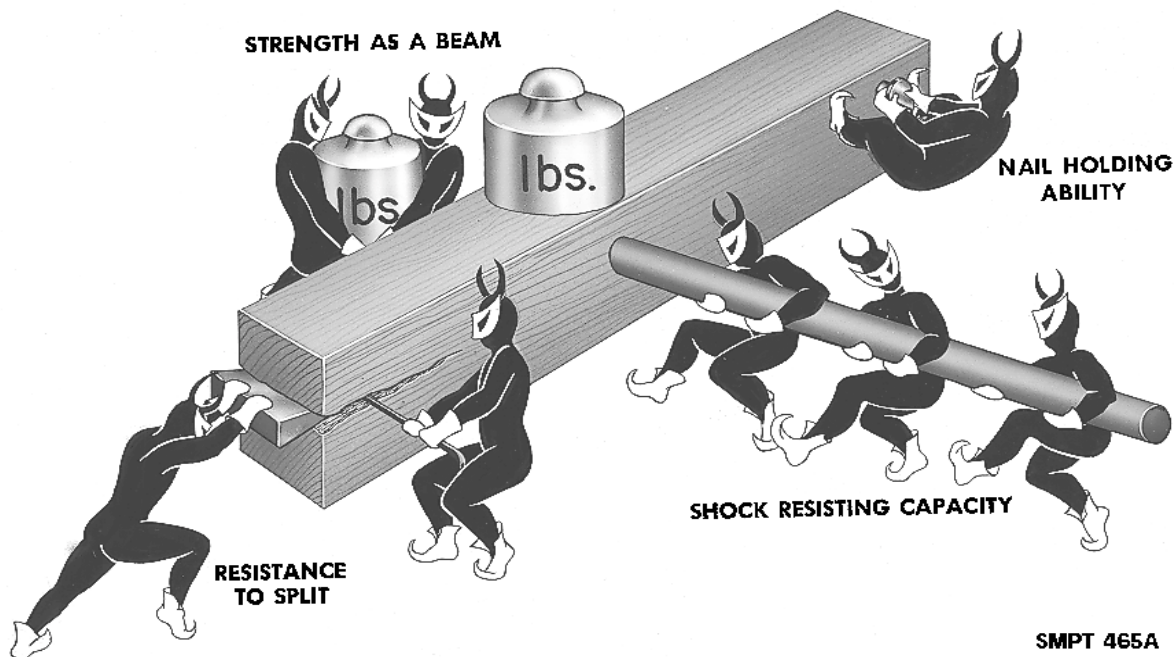


Figure 3-1. Characteristics for the classifications of wood.

Group IV includes the true hardwoods such as oak, hard maple, and hickory. These woods have the greatest shock resistance and nail-holding power, are extremely strong, but are very susceptible to splitting. They are the heaviest and hardest woods, and are difficult to work.

Wood Defects

All boards should be cut to the correct length and be free from all defects that materially weaken them, expose the contents of the box to damage, or interfere with the prescribed fabrication or nailing (fig 3-2).

Knots. Knots in wood are most weakening when located in the middle third of the length of the board. Across the width of the board, the weakening effect is proportional to the effective diameter of the knots, measured as shown in fig 3-3. No knot, or series of knots across the face of the board, within a length equal to the width of the board, shall have a diameter or sum of diameters greater than one third the width of the board. No knot will exceed 4 inches when measured across the width of the board.

Slope of grain. Any board with a slope of grain steeper than a ratio of 1 in 10 of length is not permissible. Figure 3-2 shows the results of excessive slope or cross grain.

Moisture Content

It is important that the moisture content of lumber required by an applicable container specification be followed. High moisture content in lumber will cause excessive tare weight. Shrinkage, due to the loss of high moisture content in the boards of a nailed wood box will cause gaps between the pieces of lumber. Shrinkage will also cause the loss of nail holding-power, splitting of the lumber at the nails, and the loosening of straps. Moisture content is determined by the use of electric moisture meters or by the oven dry method, as outlined in ASTM D 1616.

Moisture Meter Method

The moisture meter method is faster than the oven dry method, but less accurate. A moisture meter consists essentially of an electrical device designed to measure the resistance or the capacitance of the wood between two electrodes in contact with the sample. The values obtained will vary with the water content of the wood. They will also vary as a result of a number of other factors, most important of which are the temperature of the wood, its species, and density. Although correction tables are furnished with each instrument which must be used for even approximations of true values, the readings obtained are still only approximations because the effect of the other variables cannot be determined with scientific accuracy. Instruments of this type cannot be used where an accuracy of plus or minus 1 percent is required.

In view of this, the moisture meter method is primarily usable for screening inspections of large lots of lumber, while the oven dry method is almost always resorted to in the event of disputes. The meter used should be capable of giving instantaneous readings of moisture content within a range of 7 to 20 percent, and should be equipped with correction tables to permit the correction of meter readings for temperature, species, and density. The meter should be adjusted prior to use in accordance with the manufacturer's instructions. When a series of readings are being made, the adjustment should be checked periodically. Batteries should be replaced whenever initial adjustment cannot be accomplished, or whenever it is obvious that inaccurate readings are being obtained because of weak batteries. The following general precautions should be observed:

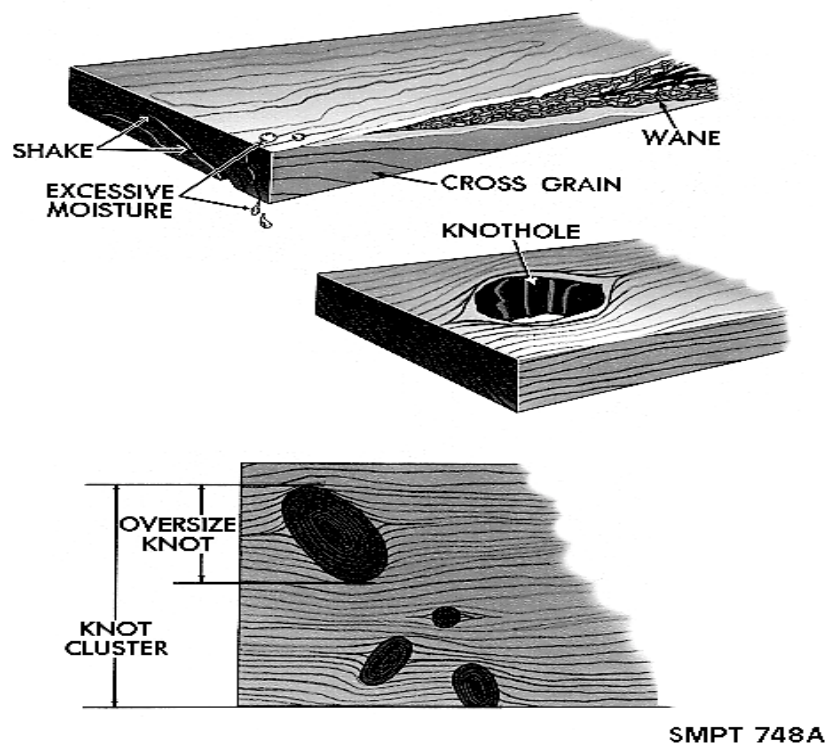


Figure 3-2. Wood defects.

- The entire area of plate-type electrodes should be in contact with the wood. Do not use this type of electrode on rough wood.
- Drive the needle-type electrodes to their full depth and in such a manner that the flow of current will be parallel to the wood grain. When wood splitting occurs discard the reading obtained. Where the wood is over one inch thick, drive 1 1/4 to 1 1/2 inch nails, spaced the same distance apart as the electrodes, straight into the wood to a depth equal to approximately one-fifth the thickness of the piece. These nails must not be cement coated but may be either bright or chemically etched.
- Never use the meter on wood whose surface is wet with rain, dew, or fog.
- Never use the meter on the ends of a piece.
- Never use the meter on a painted or otherwise finished piece.
- Never use the meter on composite pieces where the current between the two electrodes will have to pass through a glue joint.
- Do not use the meter on a piece just removed from the kiln since the temperatures correction tables (which are concerned with the temperature of the piece) will not be applicable.
- On thin pieces, do not support the piece on another piece of lumber, metal, or other material which may give false electrical readings.

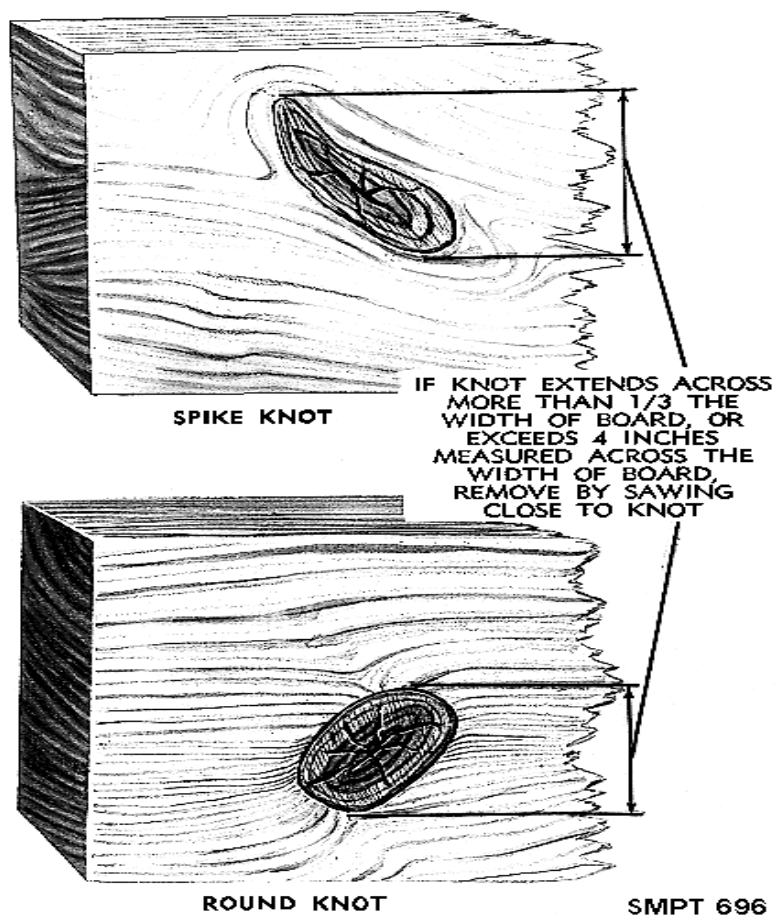


Figure 3-3. Measuring knot diameters.

Oven Dry Method

Use a drying oven capable of maintaining a constant temperature of 212°F. to 221°F., and a scale that is accurate to within one-half of 1 percent. To determine the moisture content, use the following procedure:

- Cut off at least the first 12 inches of the piece in order to avoid the effects of end drying.
- As soon as possible, cut off a piece approximately 1 inch the full thickness by the full width of the piece.
- Immediately after sawing, remove all loose splinters and determine W, the weight before drying.
- Place the wood in the hot oven and leave overnight. The next day, weigh the specimen and replace in the oven. Repeat at 2-hour intervals until the weight is the same at the end of two successive 2-hour periods. This will occur after approximately 24 hours. If more than one specimen must be open-piled in the oven to allow free access of air to all parts of the pieces.
- The final weight of the piece immediately after removal from the oven is D, the oven dry weight.
- Calculate the percentage of moisture content by using the following formula:

$$(W-D)$$

$$\frac{\quad}{W} \times 100 = \% \text{ Moisture}$$

OTHER MATERIAL SKIDS USED IN CONTAINER CONSTRUCTION

The following additional materials are used in container construction as applicable.

Nails (ASTM F 1667-95)

These may be box, corker, sinker, cooler, or common nails. Sinker and cooler nails are relatively slender, can be driven into denser woods and withstand shocks well. The heads do not break off or pull through the wood easily (fig 3-4). The resistance of nails to withdrawal varies with a number of factors such as the hardness or density of the wood, surface condition of the nails and the shape and form of nails. Dense woods hold nails much better than soft woods. To get the same nail strength with softer woods, more nails or larger nails are required. The use of chemically etched or coated nails is particularly important with soft woods. Resistance of nails to withdrawal also varies with the area of contact of the nail with the wood, increasing directly with the diameter of the nail and the depth of penetration. Nails may be subjected to forces which withdraw them directly, that is, in the direction of their length, or to forces which displace them laterally. Nails offer greater resistance to lateral displacement than to direct withdrawal. Cement coating or etching increases the resistance of nails in direct withdrawal more than in lateral withdrawal, since the nail shank is distorted in lateral withdrawal about the same, whether coated or uncoated. Etched nail surfaces have certain advantages over cement coated surfaces. The effect of etching in increasing withdrawal resistance is relatively permanent, while cement coatings deteriorate a few months after nailing. Etched nails are effective with woods of all densities, while cement coatings tend to rub off when nails are driven into dense woods. Here is a simple procedure for etching nails. Prepare a 10 percent solution (by weight) of commercial monoammonium phosphate in water. Do not use metal container for preparing or storing the solution. Keep the solution near room temperature (about 68°). Immerse the nails in the solution for about 7 hours, stirring

occasionally. Five gallons of solution is sufficient to etch about 100 pounds of nails and rinse with water. Finally, airdry the nails to prevent rusting.

Screws (FF-S-111) Sometimes it is particularly desirable to use screws for closing wooden boxes when the contents are such that they need to be checked, lubricated, or inspected.

Corrugated Fasteners (FF-F-133)

Corrugated fasteners are used in the construction of built-up faceboards in wooden boxes (figure 3-11). When used for this purpose, nailing machine operators do not have to align each board prior to nailing. Corrugated fasteners also help to prevent pilferage of contents during storage or shipment.

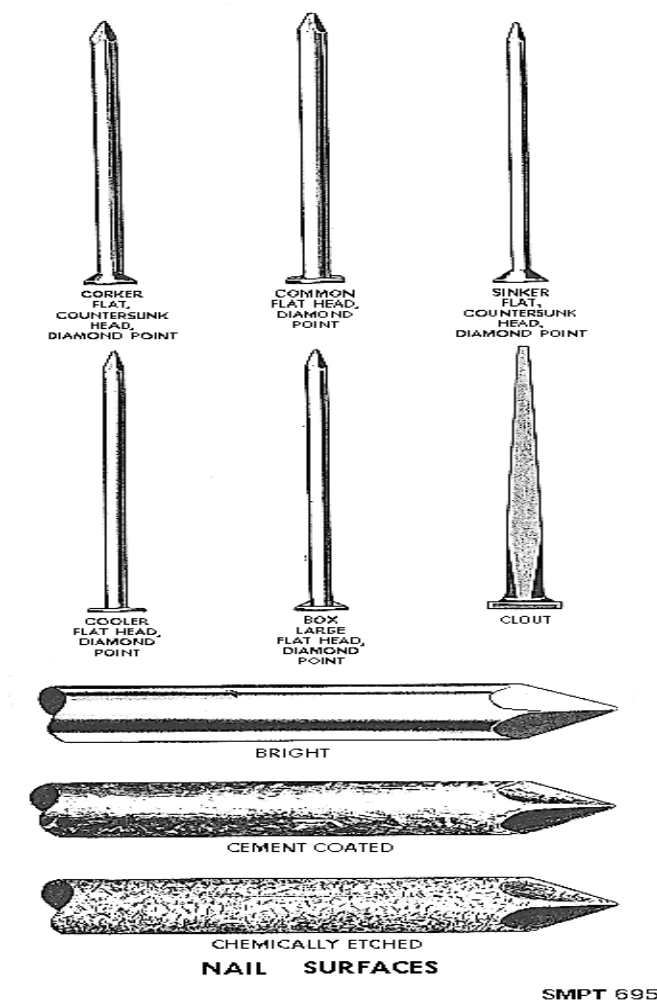


Figure 3-4. Nails.

Staple (ASTM F 1667)

Staples are used to attach cleats to panels on cleated-panel boxes. Staples with crowns not less than one-half inch must be long enough to penetrate the thickness of both the panel material and the cleat with a minimum clinch of one-eighth of an inch.

Wire Fasteners

Fasteners, other than nails, and staples, may be used to attach cleats to plywood or veneer panels. They must provide lateral displacement equal to that of nails properly spaced and driven. Wire fasteners are formed and driven by machine from a roll of knurled wire.

Strapping

Either flat metal or round wire conforming to ASTM D 3953, ASTM D 4675, and ASTM D 3950, to strap wooden containers.

Plywood (A-A-55057)

Plywood used for boxes, either for domestic or oversea destinations, shall be as specified in the procurement document or other directive establishing the container requirements. Plywood will be purchased in accordance with A-A-55057.

Fiberboard (ASTM-D-4727)

For oversea cleated panel boxes, solid V-board with a minimum dry bursting strength of 400 pounds is the only material authorized. For domestic cleated panel boxes, either solid fiberboard, solid pulp-board, or double-faced corrugated board may be used.

Paper Overlaid Veneer

This material, made of thin veneer covered on both faces with heavy kraft paper, is used as panelling material for paper overlaid veneer boxes, conforming to PPP-B-576.

NAILED AND LOCK-CORNER WOOD BOXES (PPP-B-621)

DESCRIPTION AND SELECTION

The nailed wood box is constructed of wood, assembled by fastening the top, sides, and bottom to the ends with nails, or by gluing the lock-corners of the sides and ends and fastening them to the top and bottom with nails. The placement of cleats on the ends or the lack of cleats determines the style of box. Nailed wood boxes will not be used if fiberboard or less expensive light-weight boxes will provide adequate protection for shipment and storage.

CHARACTERISTICS

Nailed wood boxes are satisfactory shipping containers for supplies and equipment, especially for items that are susceptible to damage. These containers have the following favorable and unfavorable characteristics.

- Favorable characteristics.
 - o Maximum protection to contents against damage due to puncture, distortion, and breakage.
 - o Ability to support loads due to stacking during transit and storage.

- o Ability to contain difficult loads without undue distortion.
- o Adaptability to complex wood blocking and bracing.
- o Adaptability to varying strengths by adjusting the style of box, thickness of materials, and group of wood.
- o Easy workability and simple construction.
- Unfavorable characteristics.
 - o High tare weight and cube.
 - o Not watertight.
 - o Tendency to crack.

Class and Grades (Fig 3-5)

The classes of nailed wood boxes are--

- *Class 1, domestic boxes.* These boxes are subject to storage, rehandling, or shipment to domestic destinations in which no sea transportation is involved. Net weight is limited to a maximum of 600 pounds (see tables 3-1 and 3-2).
- *Class 2, oversea boxes.* These boxes are subject to storage, rehandling, or reshipment to offshore and oversea destinations. Net weight is limited to a maximum of 1,000 pounds. Class 2 boxes (all styles) shall be furnished in the following grades, as specified. When no grade is specified in the contract, purchase order, or other procurement document, Grade B shall be supplied (see tables 3-3 and 3-4).
 - o Grade A--With preservative treatment.
 - o Grade B--Without preservative treatment.

Styles and Limitations

Class 1 and 2 boxes are described simultaneously, as applicable, in the coverage of the box styles. Styles 1, 2, 2 1/2, 4, 4 1/2, 5, 6, and 7 are permitted for Class 1 (domestic) and Styles 2, 2 1/2, 4, 4 1/2, 5, and 7 are permitted for Class 2 (oversea) shipments. Weight limitations for each class, as applicable, are given under the description of each style of box.

Style 1 Box (fig 3-6)

Style 1 box is identified by lack of cleats on the end faceboards and single line nailing of sides to ends, and of top and bottom to ends and sides. Style 1 box is intended for domestic shipments only. It is restricted to Type 1 and 2 loads. Style 1 box may not exceed a load limit of 50 pounds for two-piece sides and 100 pounds for one-piece sides. Direction of the grain on Style 1 box must run in the direction of the greatest dimension. This box is limited to a height of 10 inches and total dimensions (length, width, and depth) of 50 inches.

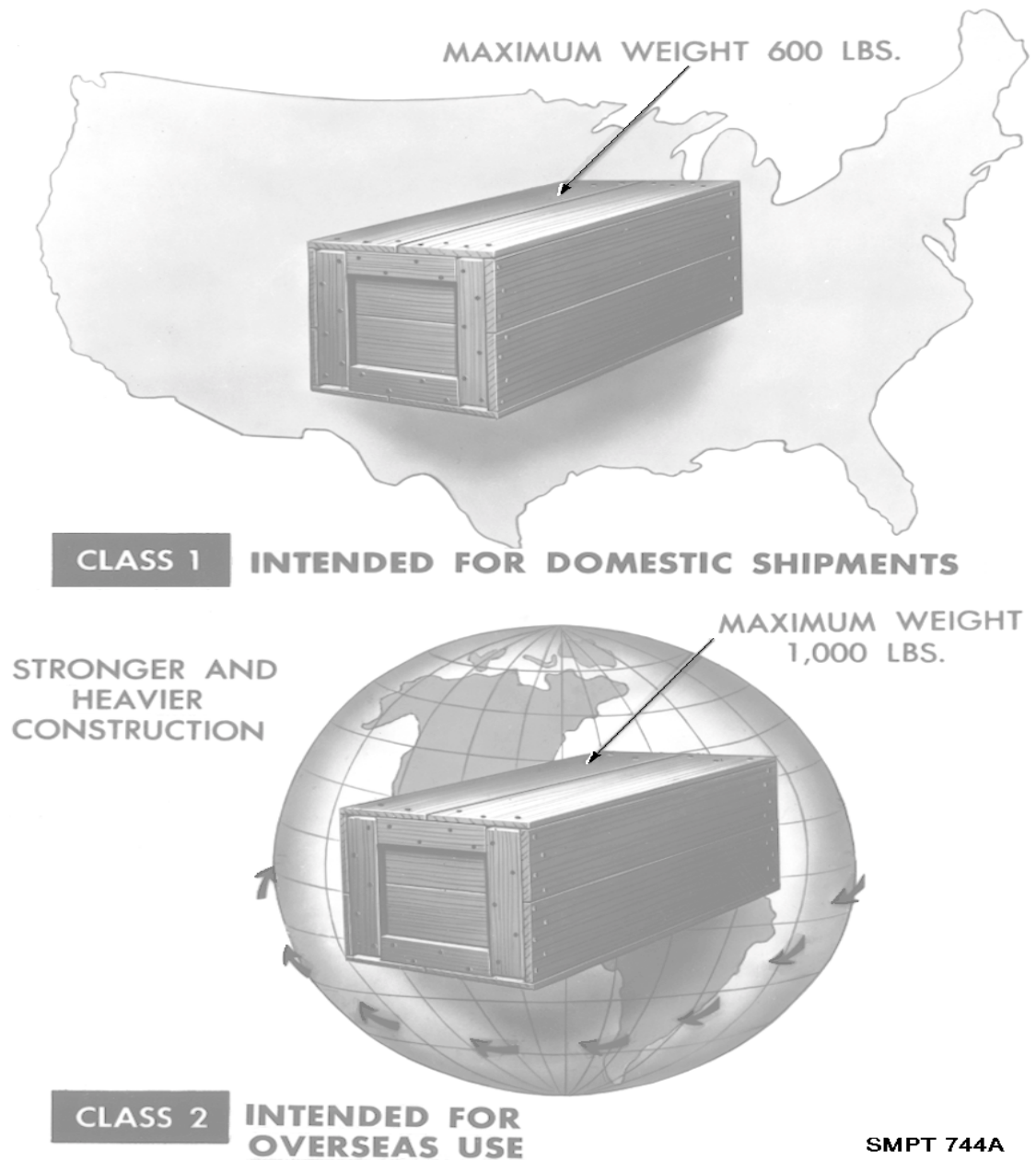


Figure 3-5. Classes of nailed wood boxes.

Style 2 Box (fig 3-6)

Style 2 box is identified by two vertical and two horizontal cleats on each end. Vertical cleats are positioned at right angles to the grain of the end. They are one-eighth of an inch shorter than the edge of the end at the top and bottom. Horizontal cleats, which are placed parallel to the grain of end, are butt-joined to the vertical cleats and are flush with the top and bottom edges of the box. The top, bottom, and sides extend over the ends and cleats and are nailed in a staggered pattern. Thus, there is some side-grain nailing on all edges. The cleat pattern provides ease of handling. Weight limitation for Style 2, Class 1 box (domestic) is 600 pounds. Weight limitation for Style 2, Class 2 (oversea) box is 1,000 pounds.

**STYLE 1 BOX****STYLE 2 BOX****STYLE 2-1/2 BOX**

SMPT 215B

Figure 3-6. Styles of nailed woods boxes.

Style 2 1/2 Box (fig. 3-6)

Style 2 1/2 box is identified by two vertical notched cleats and two horizontal cleats on each end. It has the same advantages as the Style 2 box but is slightly higher in cost. Vertical cleats are notched approximately one-fourth to three-eighths inch to support the horizontal cleats. Vertical cleats are positioned one-eighth inch above the bottom edge of the end. Weight limitation for Style 2 1/2, Class 1 box (domestic) is 600 pounds. Weight limitation for Style 2 1/2, Class 2 box (oversea) is 1,000 pounds.

Style 4 Box (fig 3-7)

Style 4 box is identified by two vertical cleats on each end. Vertical cleats, which are positioned at right angles to the grain of the end, are one-eighth inch shorter than the outside surfaces of the top and bottom of the box. The top and bottom cover the sides. They fit between the cleats and are attached to the ends by straightline, side-grain nailing. The sides overlap the ends and cleats, providing for a staggered nailing pattern. Weight limitation for Style 4, Class 1 box (domestic) is 250 pounds. Weight limitation for Style 4, Class 2 box (oversea) is 400 pounds.

Style 4 1/2 Box (fig 3-7)

Style 4 1/2 box is identified by two horizontal end cleats. Horizontal cleats, which are positioned at right angles to the grain of the end, are one-eighth inch shorter than the outside surface of the sides. The sides extend over the ends, and provide for straight-line, side-grain nailing. The top and bottom extend over the ends and cleats, and provide for both side- and end-grain nailing. Weight limitations for both classes of boxes are the same as for Style 4 boxes.

Style 5 Box (fig 3-7)

Style 5 box is identified by interior vertical cleats. The cleats extend to within one-eighth inch from the top and bottom edges of the end of the box. Other than the placement of cleats, construction and nailing pattern for this container is the same as for Style 4 box. The interior cleats may be rectangular or triangular, provided the cross section area of the triangular cleat is not less than that of the required rectangular cleat. Weight limitation for Style 5, Class 1 box (domestic) is 250 pounds. Weight limitation for Style 5, Class 2 box (oversea) is 400 pounds.

Style 6 Box (fig 3-7)

Style 6 box is identified by the lockcorner construction which is glued. This box has about the same advantages and disadvantages as Style 1 box. Style 6 box is intended for domestic shipments only and Type 1 and 2 loads. This box has a weight limitation of 50 pounds, but may go to 100 pounds if the box has one-piece sides.

Style 7 Box (fig 3-8)

Style 7 box is an internally reinforced box consisting of a skidded base with a separate hood assembled from the top, sides and ends. Style 7 boxes are for contents ranging from 100 to 1,000 pounds. The contents must readily permit attachment to the skids. The base is assembled to 2 X 4 inch skids to facilitate mounting to a skid base. The skids are positioned across the extreme ends of the bottom pieces to permit attachment of all end pieces to the skid edges. Vertical and horizontal framing members and reinforcing members in the form of a rectangle, and cross diagonals, as applicable, are attached to the interior surfaces of the prefabricated box panels. Framing members are required when contents exceeds 250 pounds or when side length is greater than end length.

End panels are identified by vertical sheathing which extends within one-eighth of an inch of each skid bottom. The hood assembly is placed over the item mounted to the base, then nailing and strapping is accomplished. Style 7 boxes are intended for both Class 1 and Class 2 use.

Shallow Box (fig 3-9)

When the inside depth of a box is five inches or less, cleats are not used. If cleats were applied to shallow boxes, they would be so small that in attaching them to the ends they would split. The end of the box may be made of one piece, or if the end is approximately square, it may be made of two pieces placed so that the grain runs in opposite directions. For Style 2, 2 1/2, 3, 4, and 4 1/2 boxes, the thickness of the ends shall be not less than the combined thickness of the end and cleat, as specified. Sides overlap the ends. Top and bottom overlap the sides and ends. Top, bottom, and sides are attached to the ends by staggered nailing. Weight limitation is 1,000 pounds for oversea shipments.

Construction Details

When nailed wood boxes are built locally, use the following information for constructing and closing the various styles. If purchased and received in shook form, the sides, top, an bottom will be ready to be attached to the constructed ends. Figure 3-10 shows the amount of acceptable splitting allowed in the component parts.

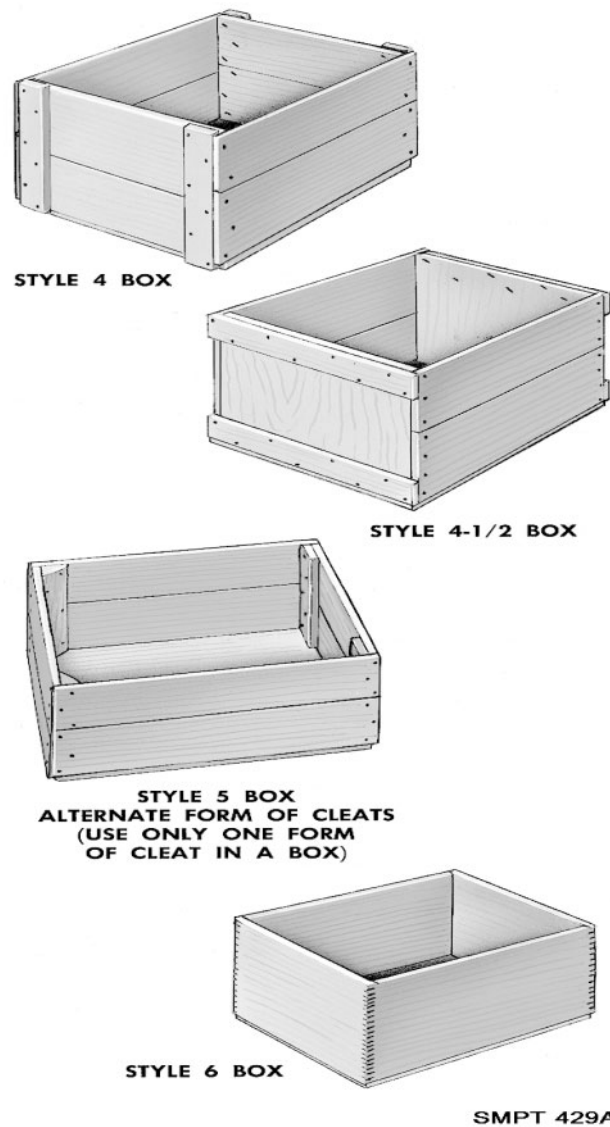


Figure 3-7. Styles of nailed wood boxes.

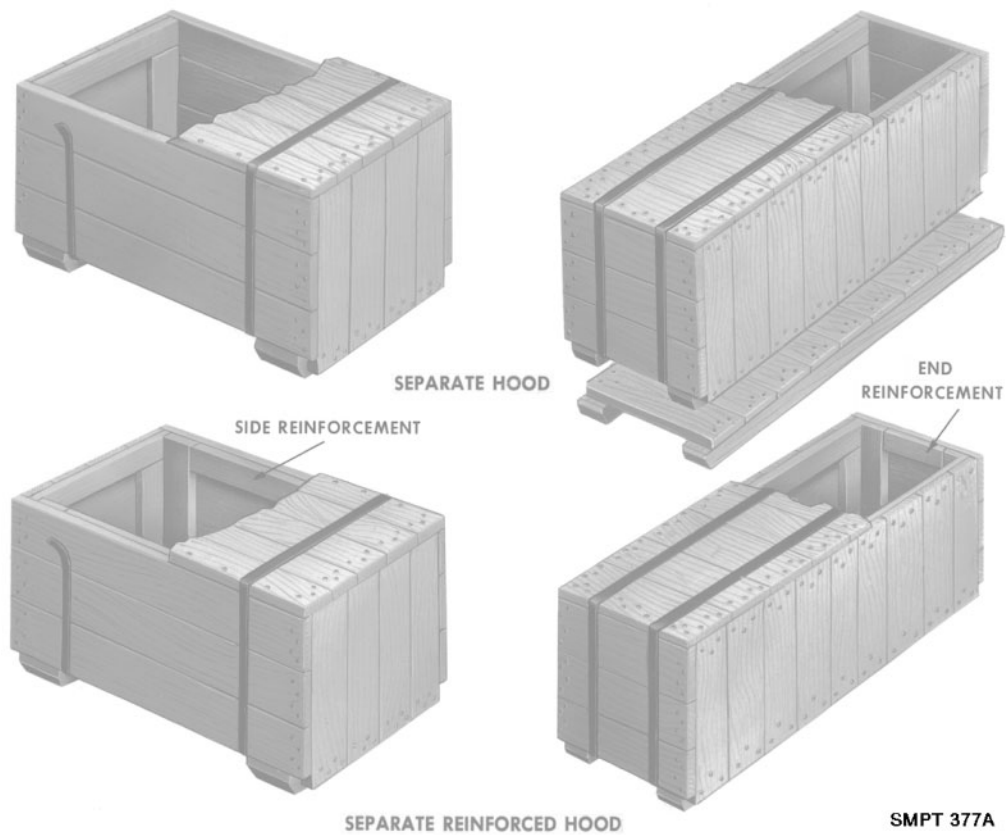


Figure 3-8. Style 7 nailed wood box.

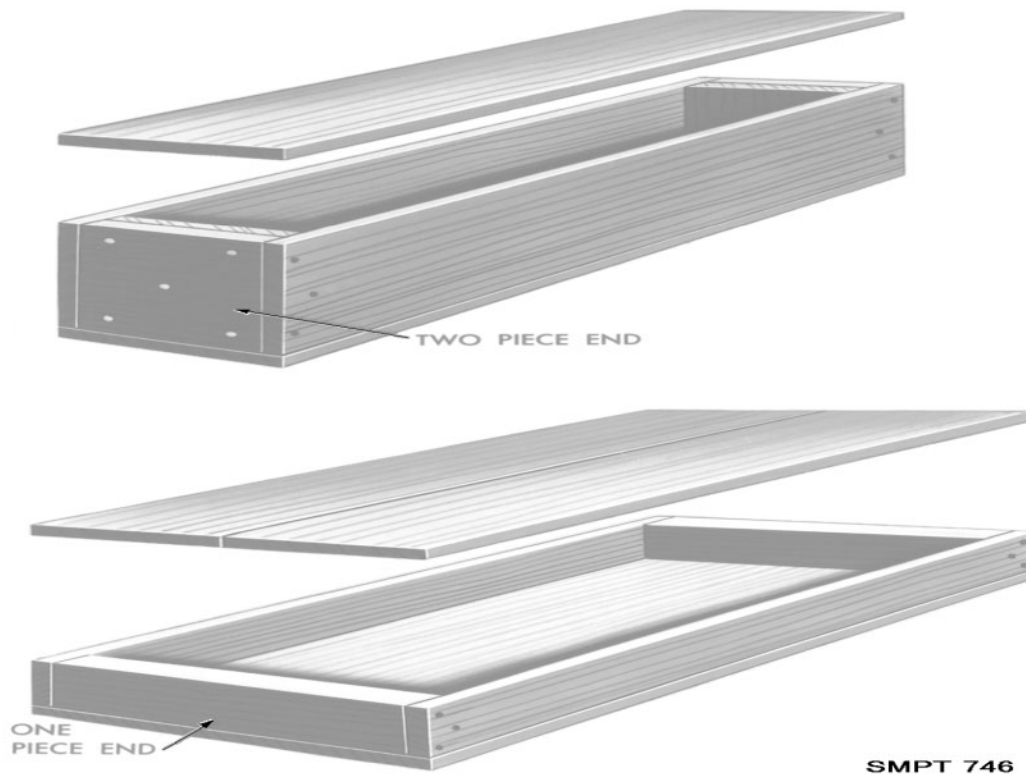


Figure 3-9. Shallow boxes.

Size of lumber

The size of lumber used in nail wood box construction is found in tables 3-1, 3-2, 3-3, and 3-4. Information necessary to use these tables is: Class of box, type of load, net weight, style of box, and group of wood.

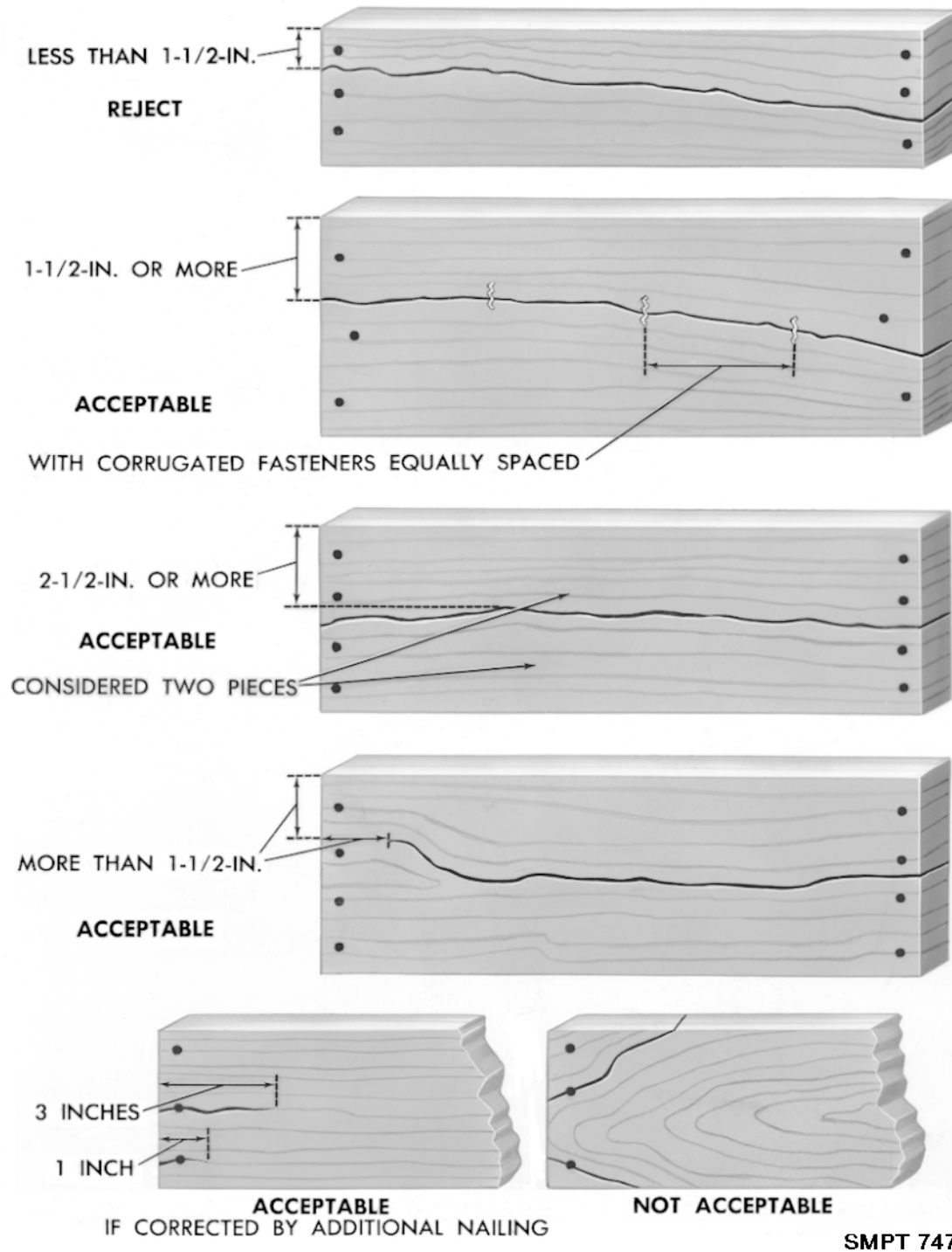


Figure 3-10. Split board rules

Construction Of Built-Up Faceboard Pieces (Fig 3-11)

The number of pieces in any side, top, bottom, or end will be chosen so that no single solid piece or built-up piece shall be less than 2 1/2 inches in width measured across the face, and will not exceed the number given in table 3-5. Built-up face-board pieces may be constructed according to the following conditions:

- The Linderman joint when glued.
- Butt joints glued under pressure.
- Tongued and grooved joints glued under pressure.
- Tongued and grooved joints glued with two or more corrugated fasteners driven from one side.
- Tongued and grooved unglued joints with two or more corrugated fasteners driven from alternate sides.

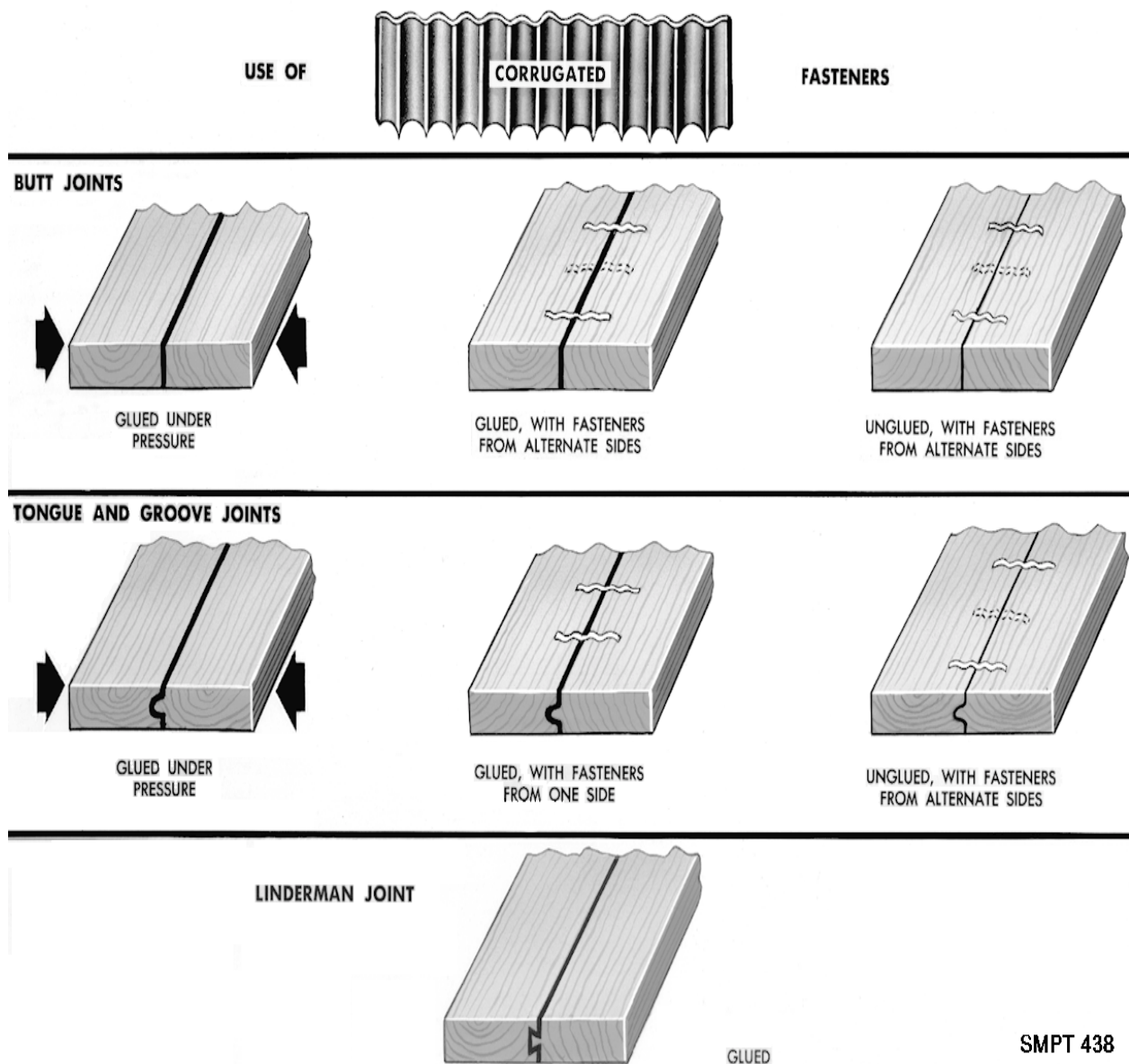


Figure 3-11. Joined pieces of lumber.

Table 3-1. Boxes for domestic shipment, type 1 (easy) and type 2 (average) loads; thickness of sides, tops, bottoms, and ends, and thickness and width of cleats.

| Weight of contents | | Style of Box ⁶ | Groups I and II woods ¹ | | | Groups III and IV woods ² | | |
|--------------------|------------------|---------------------------|---------------------------------------|-------------------|-------------------------------|---------------------------------------|-------------------|--|
| Exceeding | Not exceeding | | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats ³ |
| Pounds | Pounds | | Inch | Inch | Inches | Inch | Inch | Inches |
| -- | 50 | 1 | 3/8 | 1/2 | -- | 1/4 | 1/2 | -- |
| -- | 50 | 4,4-1/2,5 | 3/8 | 1/2 | 1/2 by 2 | 1/4 | 1/2 | 1/2 by 1-3/4 |
| -- | 50 | 2 | 3/8 | 3/8 | 3/8 by 2 | 1/4 | 3/8 | 3/8 by 1-3/4 |
| -- | 50 | 6 | 3/8 | 1/2 | -- | 1/4 | 3/8 | -- |
| 50 | 100 | 1 ⁴ | 3/8 | 1 | -- | 3/8 | 3/4 | -- |
| 50 | 100 | 4,4-1/2,5 | 3/8 | 5/8 | 5/8 by 3 | 3/8 | 1/2 | 1/2 by 1-3/4 |
| 50 | 100 | 2,2-1/2 | 3/8 | 1/2 | 1/2 by 2 | 3/8 | 1/2 | 1/2 by 1-3/4 |
| 50 | 100 | 6 ⁴ | 3/8 | 1 | -- | 3/8 | 1/2 | -- |
| 100 | 250 | 4,4-1/2,5 | 1/2 | 5/8 | 5/8 by 3 | 1/2 | 1/2 | 1/2 by 2-1/4 |
| 100 | 250 | 2, 2-1/2,7 | 1/2 | 5/8 | 5/8 by 3 | 1/2 | 1/2 | 1/2 by 1-3/4 |
| 250 | 400 ⁵ | 2, 2-1/2,7 | 5/8 | 1 | 1 by 3 | 1/2 | 3/4 | 3/4 by 2-1/4 |

¹Nominal. The dressed sizes of wood shall equal or exceed the minimum sizes shown in Table I of 20-70. For the purpose of this specification, reference to STD 20-70 shall be limited to the above.

²Thickness tolerance shall be " 1/16 inch for parts 3/8 inch thick and thicker, except as otherwise specified. Thickness tolerance shall be + 1/16 - 1/32 inch for pieces less than 3/8 inch thick.

³Width tolerance shall be " 1/16 inch, except as otherwise specified.

⁴Providing the boxes have one-piece solid sides of sawed lumber and contents are packed in interior containers.

⁵When load to be carried by the box exceeds 400 pounds, use Table 3-3; when load exceeds 600 pounds, use Table 3-4.

⁶Styles 2, 2-1/2, 4, 4-1/2 boxes. Unless otherwise specified, when the inside depth of a box is 5 inches or less, end cleats shall not be used. Thickness of the ends shall be not less than the combined thickness of the end and cleat, as specified. Each side and end shall be made from one piece, except when the end is approximately square, a two-piece end may be used with each end piece of approximately equal thickness, and with the grain of each piece running at right angles to the other. Two-piece ends shall be nailed together with at least two clinched nails.

Table 3-2. Boxes for domestic shipment, type 3 (difficult) loads; thickness of sides, top, bottoms, and ends, and thickness and width of cleats.

| Weight of contents | | Style of Box ⁵ | Groups I and II woods ¹ | | | Groups III and IV woods ² | | |
|--------------------|------------------|---------------------------|---------------------------------------|-------------------|-------------------------------|---------------------------------------|-------------------|--|
| Exceeding | Not exceeding | | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats ³ |
| Pounds | Pounds | | Inch | Inch | Inches | Inch | Inch | Inches |
| - | 50 | 4,4-1/2,5 | 3/8 | 5/8 | 5/8 by 2 | 3/8 | 1/2 | 1/2 by 1-3/4 |
| 50 | 100 | 4,4-1/2,5 | 1/2 | 1 | 1 by 3 | 1/2 | 1/2 | 1/2 by 1-3/4 |
| 50 | 100 | 2,2-1/2 | 1/2 | 5/8 | 5/8 by 2 | 1/2 | 1/2 | 1/2 by 1-3/4 |
| 100 | 250 | 4,4-1/2,5 | 5/8 | 1 | 1 by 3 | 1/2 | 3/4 | 3/4 by 2-1/4 |
| 100 | 250 | 2,2-1/2,7 | 5/8 | 1 | 1 by 3 | 1/2 | 1/2 | 1/2 by 2-1/4 |
| 250 | 400 | 2,2-1/2,7 | 1 | 1 | 1-1/4 by 4 | 3/4 | 3/4 | 3/4 by 2-1/4 |
| 400 | 600 ⁴ | 2,2-1/2,7 | 1 | 1 | 1-1/4 by 4 | 3/4 | 3/4 | 3/4 by 2-5/8 |

¹Nominal. The dressed size of the wood shall equal or exceed the minimum sizes shown in Table I of STD 20-70. For the purpose of this specification, reference to STD 20-70 shall be limited to the above.

²Thickness tolerance shall be " 1/16 inch, for parts 3/8 inch thick and thicker unless otherwise specified.

³Width tolerance shall be " 1/16 inch, unless otherwise specified.

⁴When load to be carried by the box exceeds 600 pounds, use Table 3-4.

⁵Styles 2, 2-1/2, 4, 4-1/2 boxes. Unless otherwise specified, when the inside depth of a box is 5 inches or less, end cleats shall not be used. Thickness of the ends shall be not less than the combined thickness of the end and cleat, as specified. Each side and end shall be made from one piece, except when the end is approximately square, a two-piece end may be used with each end piece of approximately equal thickness, and with the grain of each piece running at right angles to the other. Two-piece ends shall be nailed together with at least two clinched nails.

Table 3-3. Boxes for overseas shipment, type 1 (easy) and type 2 (average) load; thickness of sides, tops, bottoms, and ends, and thickness and width of cleats.

| Weight of contents | | Style of box ¹ | Groups I and II woods ² | | | Groups III and IV woods ³ | | |
|--------------------|---------------|---------------------------|--|----------------------|----------------------------------|---------------------------------------|-------------------|----------------------------------|
| Exceeding | Not exceeding | | Thickness of sides, tops, and bottoms 2/ | Thickness of ends 2/ | Thickness and width of cleats 2/ | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats 4/ |
| Pounds | Pounds | | Inch | Inch | Inches | Inch | Inch | Inches |
| -- | 50 | 4,4-1/2,5 | 3/8 | 5/8 | 5/8 by 2 | 3/8 | 1/2 | 1/2 by 1-3/4 |
| 50 | 100 | 4,4-1/2,5,7 | 1/2 | 1 | 1 by 3 | 3/8 | 1/2 | 1/2 by 1-3/4 |
| 100 | 250 | 4,4-1/2,5 | 5/8 | 1 | 1 by 3 | 1/2 | 3/4 | 3/4 by 2-1/4 |
| 100 | 250 | 2,2-1/2,7 | 5/8 | 5/8 | 5/8 by 3 | 1/2 | 1/2 | 1/2 by 2-1/4 |
| 250 | 400 | 4,4-1/2,5 | 1 | 1 | 1 by 3 | 3/4 | 3/4 | 3/4 by 2-1/4 |
| 250 | 400 | 2,2-1/2,7 | 1 | 1 | 1 by 3 | 3/4 | 3/4 | 3/4 by 2-1/4 |
| 400 | 600 | 2,2-1/2,7 | 1 | 1 | 1 by 3 | 3/4 | 3/4 | 3/4 by 2-1/4 |
| 600 | 1000 | (see Table 3-4) | | | | | | |

¹Styles 2, 2-1/2, 4, 4-1/2 boxes. Unless otherwise specified, when the inside depth of a box is 5 inches or less, end cleats shall not be used. Thickness of the ends shall be not less than the combined thickness of the end and cleat as specified. Each side and end shall be made from one piece, except when the end is approximately square, a two-piece end may be used with each piece of approximately equal thickness, and with the grain of each piece running at right angles to the other. Two-piece ends shall be nailed together with at least two clinched nails.

²Nominal. The dressed sizes of the wood shall equal or exceed the minimum sizes shown in Table I of STD 20-70. For the purposes of this specification, reference to STD 20-70 shall be limited to the above.

³Thickness tolerance shall be plus or minimum 1/16 inch for parts 3/8 inch thick and thicker, unless otherwise specified.

⁴Width tolerance shall be 1/16 inch unless otherwise specified.

Table 3-4. Boxes for overseas shipment, type 3 (difficult) load; thickness of sides, tops, bottoms, and ends, and thickness and width of cleats.

| Weight of contents | | Style of box ¹ | Groups I and II woods ² | | | Groups III and IV woods ³ | | |
|--------------------|---------------|---------------------------|--|--------------------------------|--|---------------------------------------|-------------------|--|
| Exceeding | Not exceeding | | Thickness of sides, tops, and bottoms ² | Thickness of ends ² | Thickness and width of cleats ² | Thickness of sides, tops, and bottoms | Thickness of ends | Thickness and width of cleats ⁴ |
| Pounds | Pounds | | Inch | Inch | Inches | Inch | Inch | Inches |
| -- | 100 | 4,4-1/2,5 | 1/2 | 1 | 1 by 3 | 1/2 | 1/2 | 1/2 by 1-3/4 |
| -- | 100 | 2,2-1/2,7 | 1/2 | 5/8 | 5/8 by 3 | 1/2 | 1/2 | 1/2 by 1-3/4 |
| 100 | 250 | 4,4-1/2,5 | 5/8 | 1 | 1 by 3 | 1/2 | 3/4 | 3/4 by 2-1/4 |
| 100 | 250 | 2,2-1/2,7 | 5/8 | 5/8 | 1 by 3 | 1/2 | 3/4 | 1/2 by 2-1/4 |
| 250 | 400 | 4,4-1/2,5 | 1 | 1-1/4 | 1-1/4 by 4 | 3/4 | 7/8 | 7/8 by 2-5/8 |
| 250 | 400 | 2,2-1/2,7 | 1 | 1 | 1-1/4 by 4 | 3/4 | 3/4 | 3/4 by 2-5/8 |
| 400 | 600 | 2,2-1/2,7 | 1 | 1 | 1-1/4 by 4 | 3/4 | 7/8 | 7/8 by 2-5/8 |
| 600 | 800 | 2,2-1/2,7 | 1 | 1-1/4 | 1-1/4 by 4 | 3/4 | 7/8 | 7/8 by 2-5/8 |
| 800 | 1000 | 2,2-1/2,7 | 1-1/4 | 1-1/2 | 1-1/2 by 5 | 7/8 | 1-3/8 | 1-3/8 by 3-1/4 |

¹Styles 2, 2-1/2, 4, 4-1/2 boxes. Unless otherwise specified, when the inside depth of a box is 5 inches or less, end cleats shall not be used. Thickness of the ends shall be not less than the combined thickness of the end and cleat as specified. Each side and end shall be made from one piece, except when the end is approximately square, a two-piece end may be used with each piece of approximately equal thickness, and with the grain of each piece running at right angles to the other. Two-piece ends shall be nailed together with at least two clinched nails.

²Nominal. The dressed sizes of the wood shall equal or exceed the minimum sizes shown in Table I of STD 20-70. For the purposes of this specification, reference to STD 20-70 shall be limited to the above.

³Thickness tolerance shall be plus or minimum 1/16 inch for parts 3/8 inch thick and thicker, unless otherwise specified.

⁴Width tolerance shall be 1/16 inch unless otherwise specified.

Table 3-5. Number of Pieces in any Box Part.

| Width of box part | | Maximum number of pieces single solid or built-up |
|-------------------|---------------|---|
| Exceeding | Not exceeding | |
| Inches | Inches | |
| 0..... | 2-1/2..... | 1 |
| 2-1/2..... | 5..... | 2 |
| 5..... | 7-1/2..... | 3 |
| 7-1/2..... | 12..... | 4 |
| 12..... | ..... | (See note) |

Note: The width of pieces in box parts exceeding 12 inches the average width of pieces shall be not less than 3 inches. No single solid or built-up piece shall be less than 2-1/2 inches in width across the space.

Additional Cleats and Battens

Additional cleats will be made of the same size lumber as the regular cleats. They are placed on the ends of a box when required, according to length of unsupported span (table 3-6). Additional cleats applied to ends run across the grain of the end (right angle to grain direction) and midway between the regular cleats. Battens are made of the same size lumber as regular cleats. Battens are used on the sides, top, and bottom when the limit of unsupported span is exceeded (table 3-6). Wherever possible, and without increasing the size of the container, battens should be placed inside the box. When battens are required to be placed on the outside of a box without skids, not less than two sets shall be attached across the sides, top, and bottom. They shall be applied so that those on the top and bottom extend over the ends of the side battens. They shall be located not less than 2 1/2 inches nor more than one-sixth the length of the box with respect to each box end. However, that distance and the interval between sets of battens shall be not more than maximum span specified in table 3-6. Exterior battens shall be applied to boxes with skids in the same manner as required for interior battens except that the bottom battens shall be fabricated from one piece of lumber a minimum of 2 1/2 inches high and 3 1/2 inches wide.

Diagonals (fig 3-12)

Sometimes diagonal reinforcing members are added to the interior or exterior surfaces of the box. Diagonals used on both the end and side panels are the same width and thickness as required for cleats and are nailed in the same manner. The presence of intermediate battens or cleats, required by table 3-6, determine the number of single diagonals on each panel. Single diagonals in each of two adjacent areas of one panel are arranged to peak at the center and bear at the upper end of the intermediate batten. Three or more diagonals in adjacent areas of one panel are arranged in a zigzag manner. When a 24-inch minimum strapping interval is required, the inner surface of the exterior diagonals must be notched slightly to permit the strapping to pass under each diagonal.

Skids

Boxes (except style 7) with items packed therein, having a gross weight in excess of 200 pounds, or containers with length and width dimensions of 48 inches by 24 inches or more and weighing more than 100 pounds, shall be provided with a minimum of two skids. The skids shall be fabricated from one piece of 2 1/2 inches high and 3 1/2 inches wide. Skids shall replace

exterior battens on box bottoms when battens are required in table 3-6. Skids shall be placed parallel to and extend the full width of the box and shall be positioned not closer than 2 1/2 inches nor more than one sixth the length of the box from each end of the box. The distance between skids, measured between the inside edges, shall not exceed the distance between battens, and when battens are not required, shall not exceed 48 inches. Additional skid(s), as required, shall be positioned so as to divide the distance between the end skids into units of equal length. When bolt fastening is provided for the item being packed, additional skids, as needed, shall be located on the box bottom so as to enable the item to be bolted through the skids. The skids shall be notched as applicable to provide clearance for either girthwise or lengthwise strapping. When 4-way fork entry is required, skids shall be a minimum of 3 1/2 inches high and 3 1/2 inches wide, cut out a minimum of 2 inches, in depth and of such width as to accommodate forks and slings for handling, and may be placed lengthwise flush with the box sides. The skids shall be secured to the box by nails. The nails shall be driven from the inside through the bottom into the skids and be clinched not less than 1/8 inch. Alternative to clinching, nails conforming to Type II, style 18 of ASTM F 1667-95 may be used of such length as to penetrate a minimum of 3/4 the thickness of the skids and shall not protrude through the skid. The nails shall be arranged in two rows in a staggered pattern, with space between nails in each row not to exceed 6 inches. Nails shall not be located less than 1/2 inch from edges of the skid nor less than approximately 1 1/2 inches from ends of the skid. Variation in specified thickness of skids may be plus or minus 1/8 inch and the variation in specified width of skids may be plus or minus 1/4 inch. When skids are specified and box requires 2 or more inside battens (table 3-6), the inside bottom battens need not be applied. However, a skid shall be attached to the outside of the box bottom placed in alignment with each side batten.

Table 3-6. Requirements for Additional Battens or Cleats.

| Thickness of ends, side, top, or bottom | | Maximum length of unsupported span |
|---|-------------------------|------------------------------------|
| Groups I and II woods | Groups III and IV woods | |
| Inches | Inches | Inches |
| ..... | 1/4 | 19 |
| 3/8 | ..... | 21 |
| ..... | 3/8 | 23 |
| 1/2 | ..... | 30 |
| ..... | 1/2 | 34 |
| 5/8 | ..... | 38 |
| ..... | 5/8 | 42 |
| ..... | 3/4 | 47 |
| 1 | ..... | 50 |
| ..... | 13/16 | 54 |
| 1-1/4 | 7/8 | 64 |

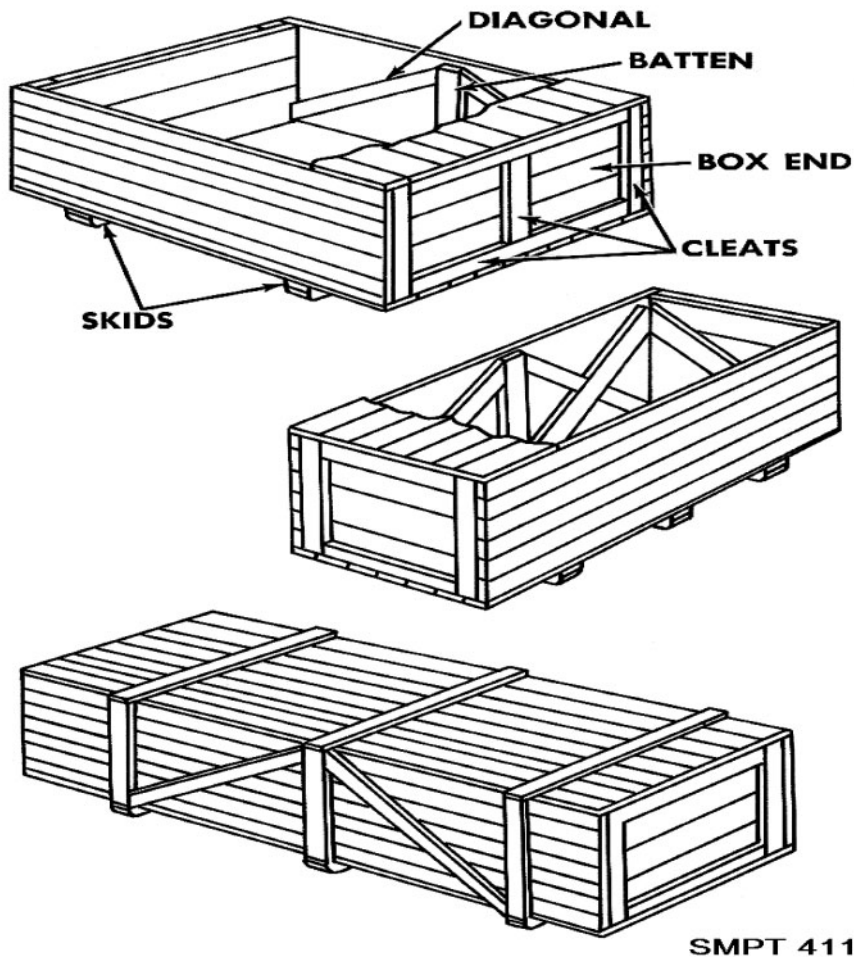


Figure 3-12. Style 2 reinforced box.

NAILING REQUIREMENTS

SPACING AND SIZES

Nail spacing and sizes will conform to tables 3-8 and 3-9.

NAILING OF TOP AND BOTTOM

When specified, the top and bottom should be nailed to the box sides.

NAIL SIZES

Sizes of nails are determined from the following information:

- Nail sizes for fastening sides, top, and bottom to ends and cleats are determined by the group of wood and thickness of the pieces being fastened together (table 3-7).
- Nail sizes to secure top and bottom to the sides are determined from the group of wood being used and the thickness of the side (table 3-8).
- Nails to fasten cleats to the ends will be long enough to penetrate both the cleat and the end and be clinched at least one-eighth of an inch. However, when eightpenny nails or smaller are used, they may be clinched not more than three-eighths inch.
- If correct nail size is not available, or splitting is encountered, one size smaller is used, and the spacing will be one-fourth of an inch closer.

NAIL SPACING

The spacing of nails is determined from the following:

- Nail spacing for fastening sides, top, and bottom to the ends will depend on the size of nails used, and whether driven into side-grain or end-grain. If nails are driven into both side- and end-grain, the spacing is the same as for end-grain nailing (table 3-9).
- Nail spacing for fastening the top and bottom to the sides of the box is determined from the thickness of sides. If the thickness of the sides is less than three-fourths of an inch, no nailing is permitted. There is a minimum and maximum spacing (table 3-8).

When attaching cleats and battens, the nails are driven in two parallel rows spaced alternately as given in table 3-9, so that the end nails are not less than three-fourths of an inch from the end of the cleat or batten. All nails shall pass through both the cleat and the end (or batten and side, top and bottom) and be clinched. Nails are driven approximately three-eighths of an inch from the edge when the cleat or batten is 2 inches or under in width, and one-half of an inch when it is over 2 inches in width.

NAILING RULES

It is imperative that poor nailing practices be avoided and correct nailing procedures be followed. Both are shown in figures 3-13 and 3-14, and stressed in the following rules:

- Each single solid piece or built-up piece in the sides, top, or bottom will have at least two nails or other acceptable fastener at each end.
- Each single piece or built-up piece is fastened to each vertical cleat or batten with not less than two nails or other acceptable fastener.
- Wherever possible, side-grain nailing should be accomplished. In nailing to both the end and the cleats, at least half of the nails are driven into the cleat.
- Where a cleat is attached to an end, at least one end nail will be adjacent to the inside edge of the cleat.
- Nails are clinched across the grain of the wood, if possible.
- Nails must be driven so that neither the head nor the point will project above the surface of the wood.
- Occasionally, overdriven nails are permitted. Nails overdriven more than one-eighth the thickness of the piece are not permitted.
- Cement-coated or chemically-etched nails have a holding power considerably greater than that of uncoated and consequently 25 percent more nails of the same size are needed when smooth nails are used in place of cement-coated or chemically-etched nails. The comparative holding power of nails is illustrated in figure 3-15. Bright, uncoated nails must be clinched.

Table 3-7. Size of cement-coated or chemically-etched cooler, sinker, and standard box nails for boxes.

| Species of wood | Thickness of ends or cleats to which sides, tops and bottoms are nailed (inch) | | | | | | | | | | | |
|-----------------|--|-------|------|------|------|-------|-------|-------|-----|-------|-------|-------|
| Group I..... | Exceeding | ..... | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 13/16 | 7/8 | 1 | 1-1/8 | 1-1/4 |
| | Not exceeding | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 13/16 | 7/8 | 1 | 1-1/8 | 1-1/4 | ..... |
| | Size of nail (penny) | 4 | 5 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 12 |
| | | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 9 | 12 |
| Group II..... | | 3 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 10 |
| Group III..... | | 3 | 3 | 4 | 4 | 4 | 5 | 6 | 7 | 8 | 8 | 9 |
| Group IV..... | | | | | | | | | | | | |

Table 3-8. Size of nails and spacing for nailing tops and bottoms to sides of boxes.

| Thickness of side (inches) | Group I wood | Group II wood | Groups III and IV woods | Spacing | |
|----------------------------|----------------------|---------------|-------------------------|---------|---------|
| | | | | Minimum | Maximum |
| Under 3/4..... | No nailing permitted | | | | |
| 3/4 thru 7/8 incl..... | 7d | 6d | 5d | 6 | 8 |
| 15/16 thru 1-1/16 incl.... | 8d | 7d | 6d | 6 | 8 |
| Over 1-1/16..... | 10d | 9d | 8d | 8 | 10 |

Table 3-9. Spacing of cement-coated or chemically-etched nails for boxes.

| Size of Nails | Spacing when driven into side grain | Spacing when driven into end grain ¹ |
|---------------------|-------------------------------------|---|
| | Inches | Inches |
| Sixpenny or smaller | 2 | 1-3/4 |
| Sevenpenny..... | 2-1/4 | 2 |
| Eightpenny..... | 2-1/2 | 2-1/4 |
| Ninepenny..... | 2-3/4 | 2-1/2 |
| Tenpenny..... | 3 | 2-3/4 |
| Twelvepenny..... | 3-1/2 | 3 |
| Sixteenpenny..... | 4 | 3 1/2 |
| Twentypenny..... | 4-1/2 | 4 |

¹When nails are alternately driven into end-grain of end and side-grain of cleat (such as nailing sides to ends in Styles 2, 2-1/2, 3, 4, 4-1/2, 5 and 7) use spacing based on driving nails into end-grain.

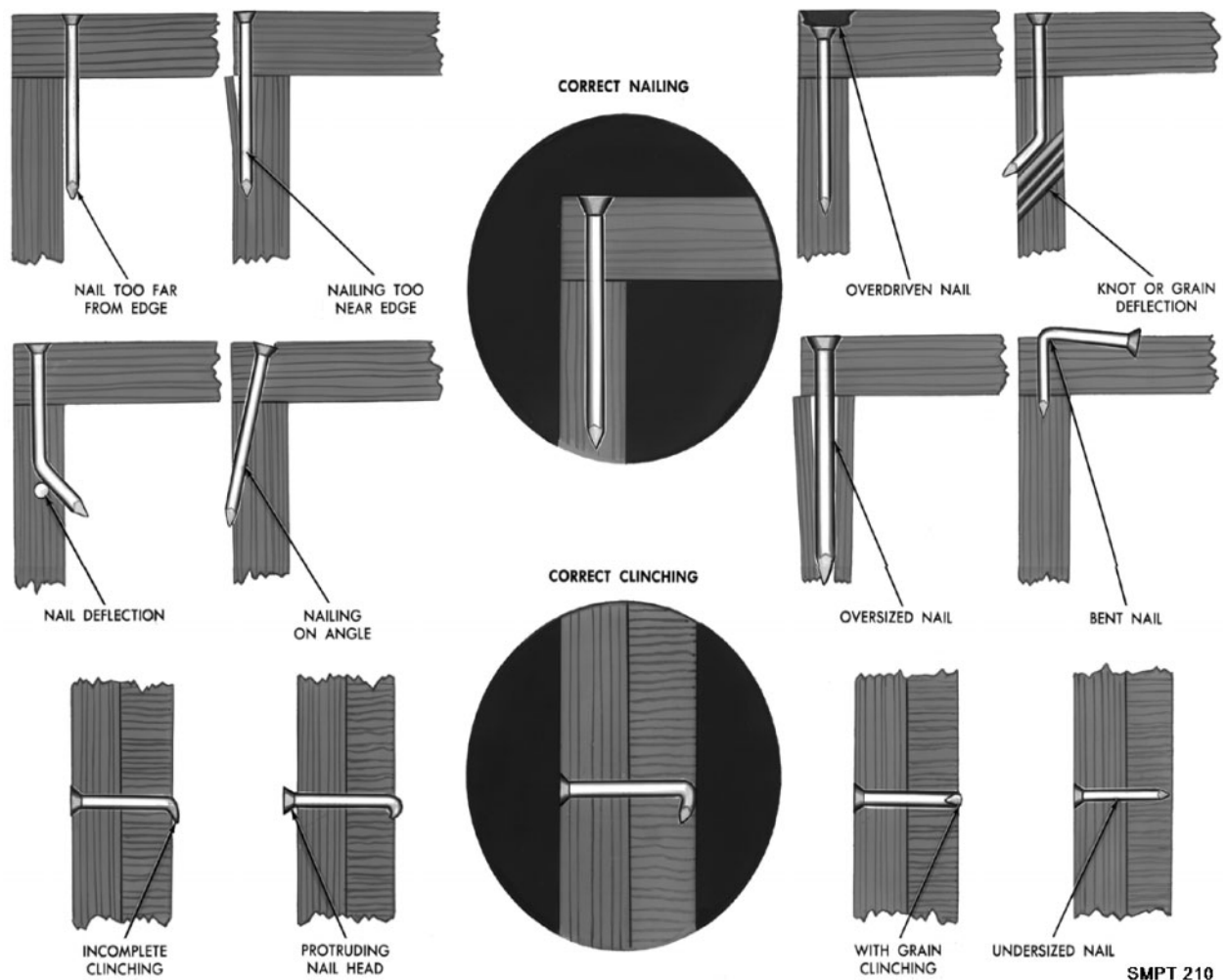


Figure 3-13. Nailing.

SETTING UP OF STYLE 1 AND 6 BOXES

The setting up of these styles is accomplished in the following order:

- Select nails and glue.
 - o Size of coated and etched nails and proper spacing is determined from tables 3-7, 3-8, and 3-9.
 - o Glue for securing sides to ends of Style 6, lock-corner box, is any commercially available water-resistant glue.
 - o Fasten the sides to the ends by straight-line nailing, using cement-coated or chemically-etched nails.
 - o Apply glue to both surfaces of the sides and ends of the lock-corners of Style 6 boxes.
 - o Nail the top and bottom.
 - o Use nails and proper spacing determined above.
 - o Secure the bottom of the box by nailing into the ends.
 - o After the load is inserted, secure the top of the box in the same manner as the bottom.

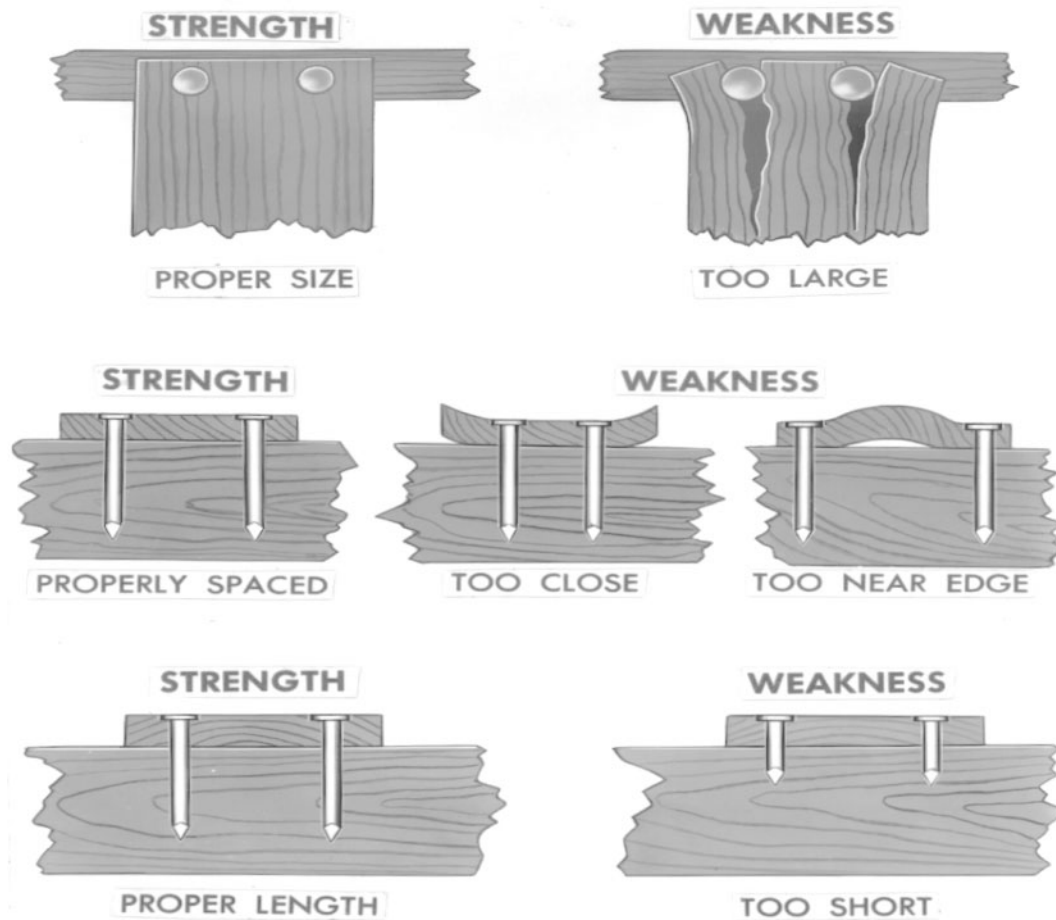


Figure 3-14. Proper and improper nailing.

SETTING UP OF STYLE 2 AND 2 1/2 BOXES

The setting up of these styles is accomplished in the following order:

- Select nails and proper spacing.
 - Select proper size and spacing of coated or etched, and bright, uncoated nails from tables 3-7 and 3-8.
 - Fasten the cleats to the ends.
 - Nail cleats to end, using a staggered nailing pattern.
 - Nails for nailing cleats to ends may be bright, uncoated, but must be clinched.
 - Position the vertical cleats on the end at right angles to the grain of the end.
 - Fasten the sides to the ends.
 - Lap the sides over the ends and cleats.
 - Nail the sides to the ends and cleats with coated or etched nails in a staggered pattern.
 - Nail the top and bottom.
 - Lap the top and bottom over the ends and cleats.
 - Nail the top and bottom to the ends and cleats with coated or etched nails in a staggered pattern.

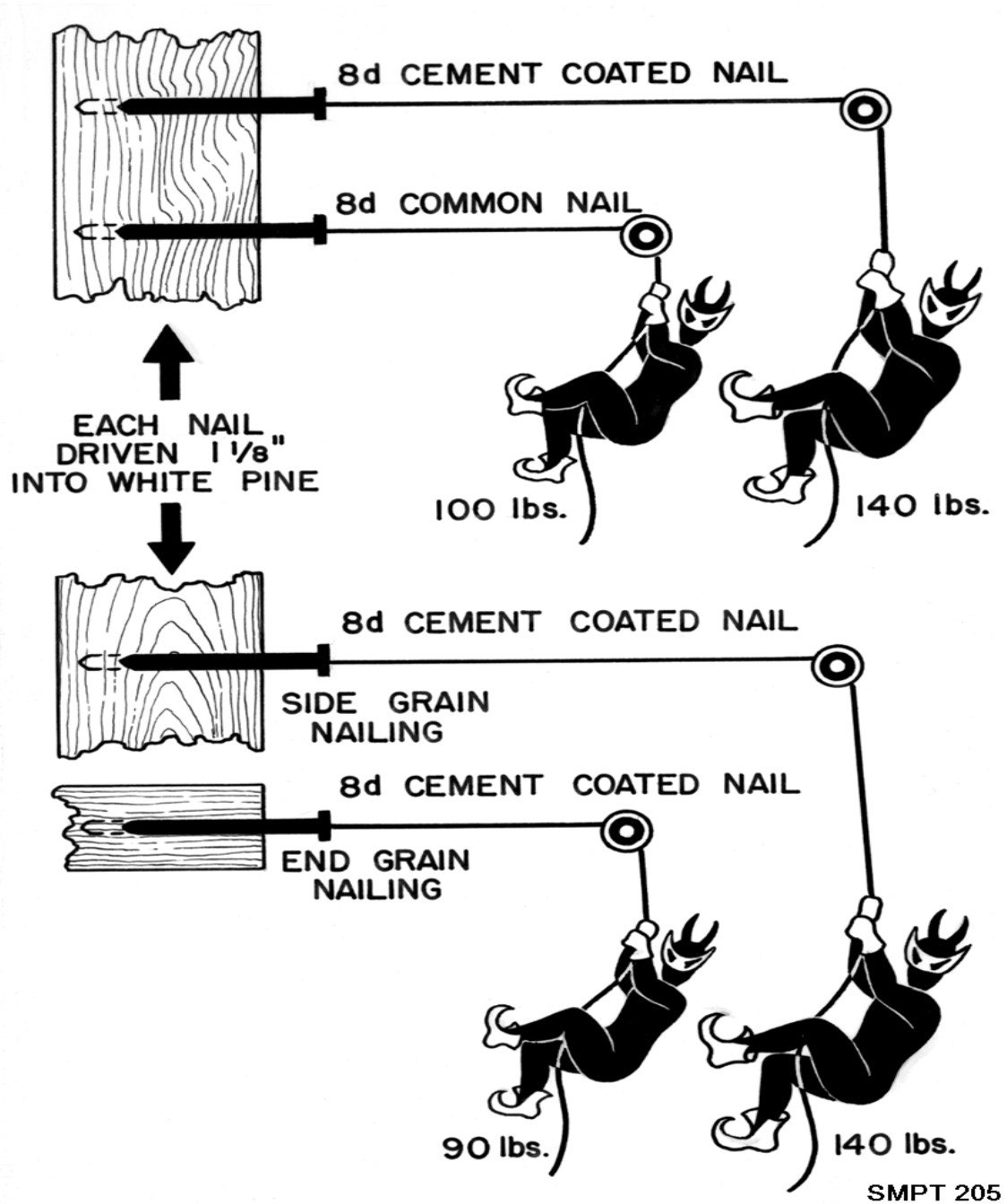


Figure 3-15. Nail holding power.

Setting up of style 4, 4 1/2, 5, and shallow boxes

The setting up of these styles is accomplished in the following order:

- Select nails and proper spacing. Select the proper size and spacing of coated or etched, and bright, uncoated nails from tables 3-7, 3-8, and 3-9.
- Fasten the cleats to the ends.
- Nail the cleats to the end using a staggering nailing pattern.
- Nails for nailing the cleats to the ends may be bright, uncoated, but must be clinched.
- Fasten the sides to the ends.
- Lap the sides over the ends and cleats on Style 4 and 5 boxes.
- Fasten the sides to the ends and cleats in a staggering nailing pattern.
- Lap the sides of Style 4 1/2 and shallow box over the ends.
- Drive the nails in a straight line for Style 4 1/2 box and in a staggered pattern for shallow boxes.
- Nail the top and bottom.
 - o Nail the bottom of the box to the ends and sides.
 - o On Style 4 and 5, boxes nail the top and bottom to the end with straightline nailing.
 - o On Style 4 1/2 and shallow boxes, nail the top and bottom to the ends with a staggered nailing pattern.

Strapping Requirements

Strapping used on nailed wood boxes may be either round or flat. Proper size of strapping is determined by the net weight of contents and the number of straps used (tables 3-10 and 3-11). All straps are applied perpendicular to the edges of the box over which they pass and are drawn tight so as to sink into the wood at the edges. Straps shall be applied just prior to shipment where practicable. Strapping requirements are found in the Appendix to Specification PPP-B-621.

CLASS 1 (DOMESTIC) BOXES

Unless otherwise specified, Style 1 and 6 boxes, regardless of weight, and Style 2, 2 1/2, 4 4 1/2, 5, and 7 boxes, with weight of contents exceeding 100 pounds, shall be strapped. When specified, Style 2, 2 1/2, 4 4 1/2, and 5 boxes, with weight of contents less than 100 pounds, shall be strapped.

CLASS 2 (OVERSEA) BOXES

All boxes used for a shipment intended for overseas shall be strapped (fig 3-16).

Placement of Straps

On most boxes, the first straps are positioned girthwise about one-sixth of the length of the box from each end, not to exceed 9 inches from the ends.

On Styles 1 and 6, the first strap is lengthwise, followed by two girthwise straps.

When strapping is required on Style 7 boxes, one strap is applied parallel to, and immediately adjoining the inner edge of each skid. Three or more straps, equally spaced, are required when spacing between straps exceeds 24 inches.

Table 3-10. Minimum gage of round wire for various weights of boxes.

| Net weight of contents | | Gage of wire when different number of wires are used | | | |
|------------------------|---------------|--|----------------------|---------------------|----------------------|
| | | Two bands | | Three or more bands | |
| Exceeding | Not exceeding | Class B | Class A | Class B | Class A |
| Pounds | Pounds | Inch | Inch | Inch | Inch |
| 0..... | 70..... | 0.0720 (15 gage) | 0.0625 (16 gage) | 0.0720 (15 gage) | 0.0625 (16 gage) |
| 70..... | 125..... | 0.0800 (14 gage) | 0.0720 (15 gage) | 0.0800 (14 gage) | 0.0720 (15 gage) |
| 125..... | 175..... | 0.0915 (13 gage) | 0.0800 (14 gage) | 0.0915 (13 gage) | 0.0800 (14 gage) |
| 175..... | 250..... | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) |
| 250..... | 400..... | 0.1055 (12 gage) | 0.0990 (12-1/2 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) |
| 400..... | 1,000..... | ..... | ..... | 0.1055 (12 gage) | 0.0990 (12-1/2 gage) |

Table 3-11. Minimum sizes of flat metal bands for various weights of boxes.

| Net weight of contents | | Dimensions of flat metal bands when different numbers of bands are used | |
|------------------------|---------------|---|---------------------|
| Exceeding | Not exceeding | Two bands | Three or more bands |
| ..... | 70..... | 3/8 by 0.015..... | 3/8 by 0.015 |
| 70..... | 125..... | 3/8 by 0.020..... | 3/8 by 0.020 |
| 125..... | 175..... | 1/2 by 0.020..... | 1/2 by 0.020 |
| 175..... | 250..... | 5/8 by 0.020..... | 5/8 by 0.020 |
| 250..... | 400..... | 3/4 by 0.020..... | 3/4 by 0.020 |
| 400..... | 1,000..... | ..... | 3/4 by 0.023 |

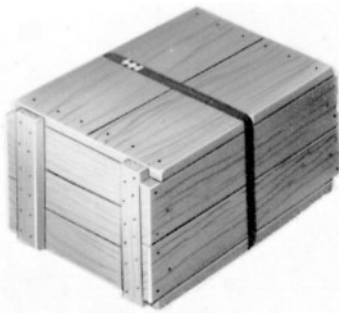
Additional straps are placed girthwise so that the distance between straps does not exceed 24 inches.

Small boxes less than 12 inches long and having less than 35 pounds of contents require only one girthwise strap. The single girthwise strap may be 16 gage round wire, or 3/8 X 0.010-inch flat strap.

When the outside length of unreinforced style 2, 2 1/2, 4, 4 1/2, 5 and shallow boxes exceeds 36 inches, three or more straps will be applied girthwise so that the distance between straps is not more than 24 inches.

Workmanship

Throughout the fabrication, setting up, nailing, and strapping of nailed wood boxes, good workmanship should be practiced at all times. Figure 3-17 shows some of the defects which must be avoided.



WEIGHT 35 LBS. OR LESS
LENGTH 12 IN. OR LESS
SEE NOTE.

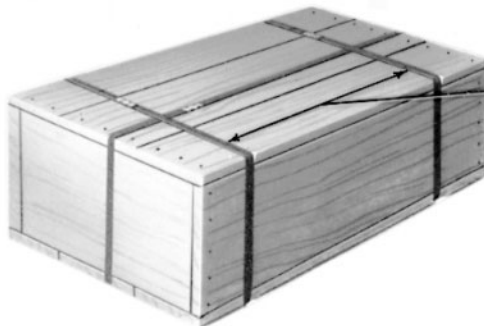
GIRTHWISE STRAPPING

ALL STYLES EXCEPT 1 AND 6
3 REQUIRED WHEN WEIGHT
EXCEEDS 400 LBS.
PLACE 1/6th LENGTH OF BOX
FROM EACH END NOT TO EXCEED
9 IN.
SEE NOTE.

NOTE:
STRAP CLASS 1
BOXES WHEN
UNDER 100 LBS.
ONLY WHEN
SPECIFIED



STYLES 1 AND 6
BOXES, ONE LENGTHWISE
STRAP PRIOR TO TWO
GIRTHWISE STRAPS



NOT TO EXCEED 24 IN.

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Figure 3-16. Strapping of nailed wood boxes.

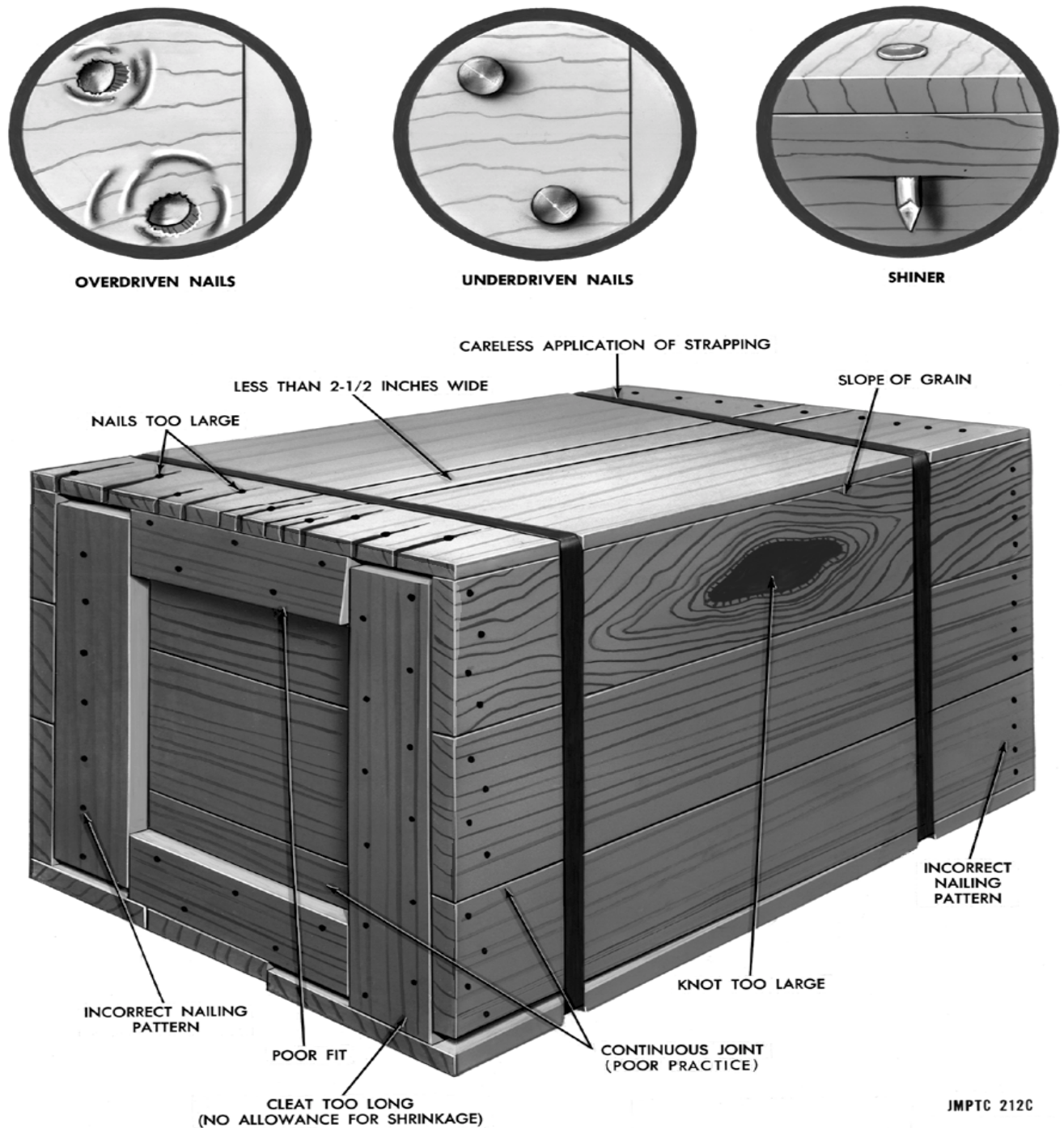


Figure 3-17. Defects of nailed wood boxes.

Preservation

When specified, each PPP-B-621 box or all of the finished wood parts shall be preserved by immersing for a minimum of one minute in one of the following wood preservative solutions: 2 percent copper Maphthenate, 3 percent zinc naphthenate, or 1.8 percent copper-8-quinolinolate. These three chemicals exhibit characteristics which are acceptable for DOD-wide use provided handling instructions prescribed by the manufacturer are followed. After the dip treatment, the boxes or wood parts must be air dried (or dried for an appropriate time in a kiln or oven) for a period of 24 hours minimum in a well-ventilated area allowing full air circulation around all surfaces of the individual wood box or wood part. The boxes or parts must be dried prior to shipment. Dryness can be determined by the absence of discoloration of the red oil soluble dye when tested as specified in PPP-B-621.

CLEATED-PANEL BOXES (GENERAL)**DESCRIPTION**

Cleated-panel boxes are made by attaching wood cleats to sheets of plywood, fiberboard, or paper-overlaid veneer to form panels that are later fastened together at the cleats to form a container. When plywood is used as panel material, they are called wood-cleated plywood boxes, specification PPP-B-601; when fiberboard is used, they are called wood-cleated fiberboard boxes, specification PPP-B-576; and when paper-overlaid veneer is used, they are called wood-cleated, paper-overlaid veneer boxes. In each type of box, the cleats act to reinforce the edges and to aid in nailing.

CHARACTERISTICS

The chief characteristics of cleated-panel boxes are: Lightweight, high resistance to diagonal distortion, resistance to corner damage, and ability to withstand severe tumbling and dropping. They are easy to mark and handle, almost dustproof, and lend themselves to easy fabrication. Panels may be bought in large quantities in the knocked-down form, which can be easily stored in a minimum of space. These boxes afford three choices of cleated panel boxes for use in the shipping of military supplies and equipment. Selection of the panel material for the box is based upon the destination of the shipment, the minimum protection required, the weight of the item, and the container limitations.

Intended Uses and Limitations

The styles of boxes permitted for domestic and oversea shipments, with limitations for cleated plywood, cleated fiberboard, and cleated paper overlaid veneer boxes are cited in table 3-12.

Oversea Type Boxes (see figure 3-18)

Styles A and B are the only ones permitted, for cleated fiberboard and veneer. Cleated plywood boxes permit Styles A, B, I, and J. Plywood and paper-overlaid boxes will take all three types of loads. Cleated fiberboard boxes will take Type 1 and 2 loads only. Style A lends itself to ease of assembly and opening. Style B has greater strength, but is more difficult to open. The designs of these boxes and their load limit for oversea shipments are given in the respective container specifications.

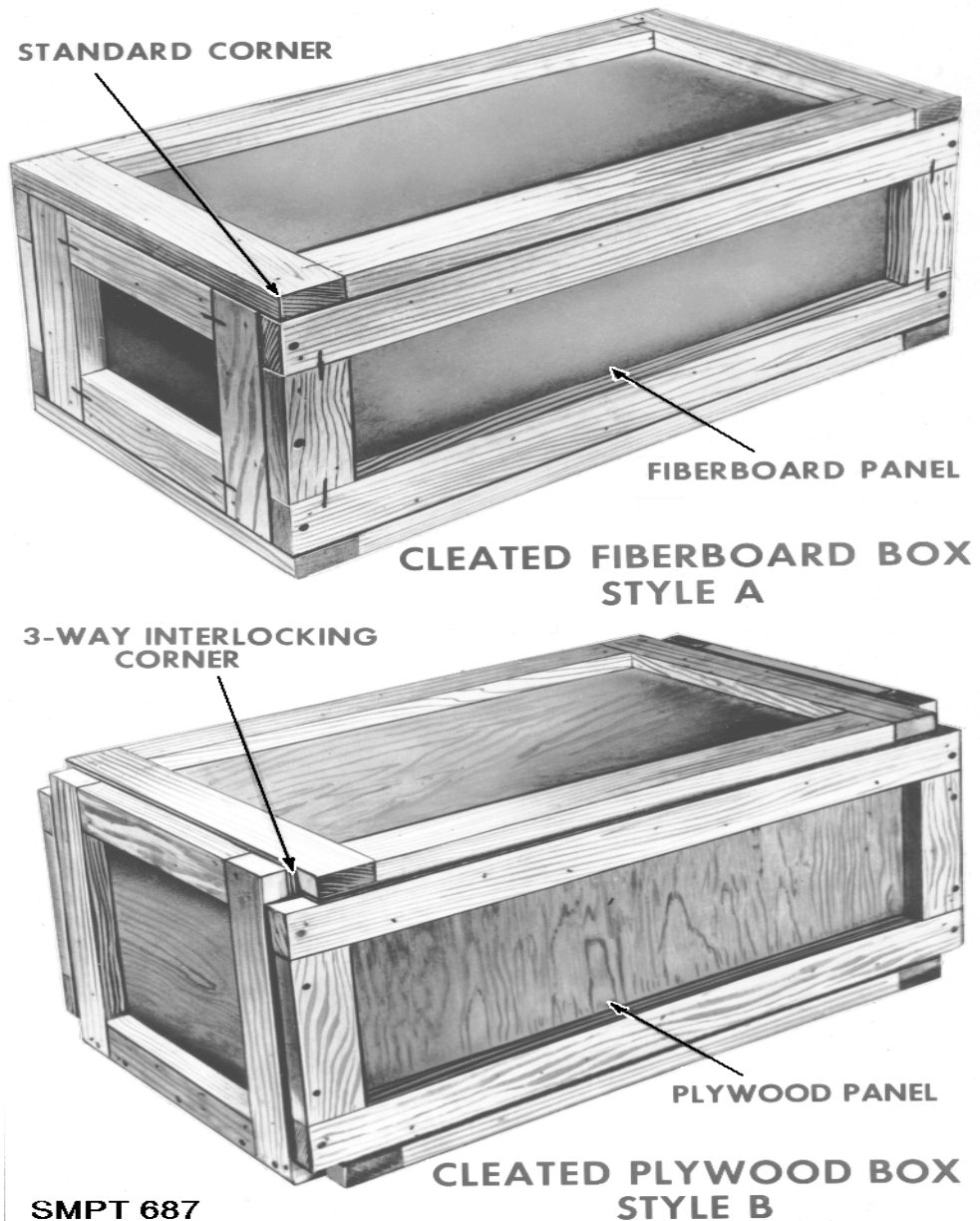


Figure 3-18. Oversea styles of cleated panel boxes.

Domestic Type Boxes (see figure 3-19)

Domestic boxes are intended for normal use when the additional strength of the overseas type is not required. The selection of the style depends largely on the nature and weight of the item, and how it is to be supported. Styles B, D, E, and G have 3-way corners and are satisfactory if the boxes are not to be opened for inspection and reclosed. If the boxes are to be opened and reclosed, Style A and K are preferred. The full-cleated Styles A and B are the strongest and most suitable for heavy items, if the weight can be applied over the entire area of any face. Styles A and B require only one size of nails for assembling the box, whereas, two sizes of nails are required for Styles C and K, inclusive. Paper-overlaid veneer boxes are only available in Styles A and B for domestic shipment. All three types of loads are permitted.

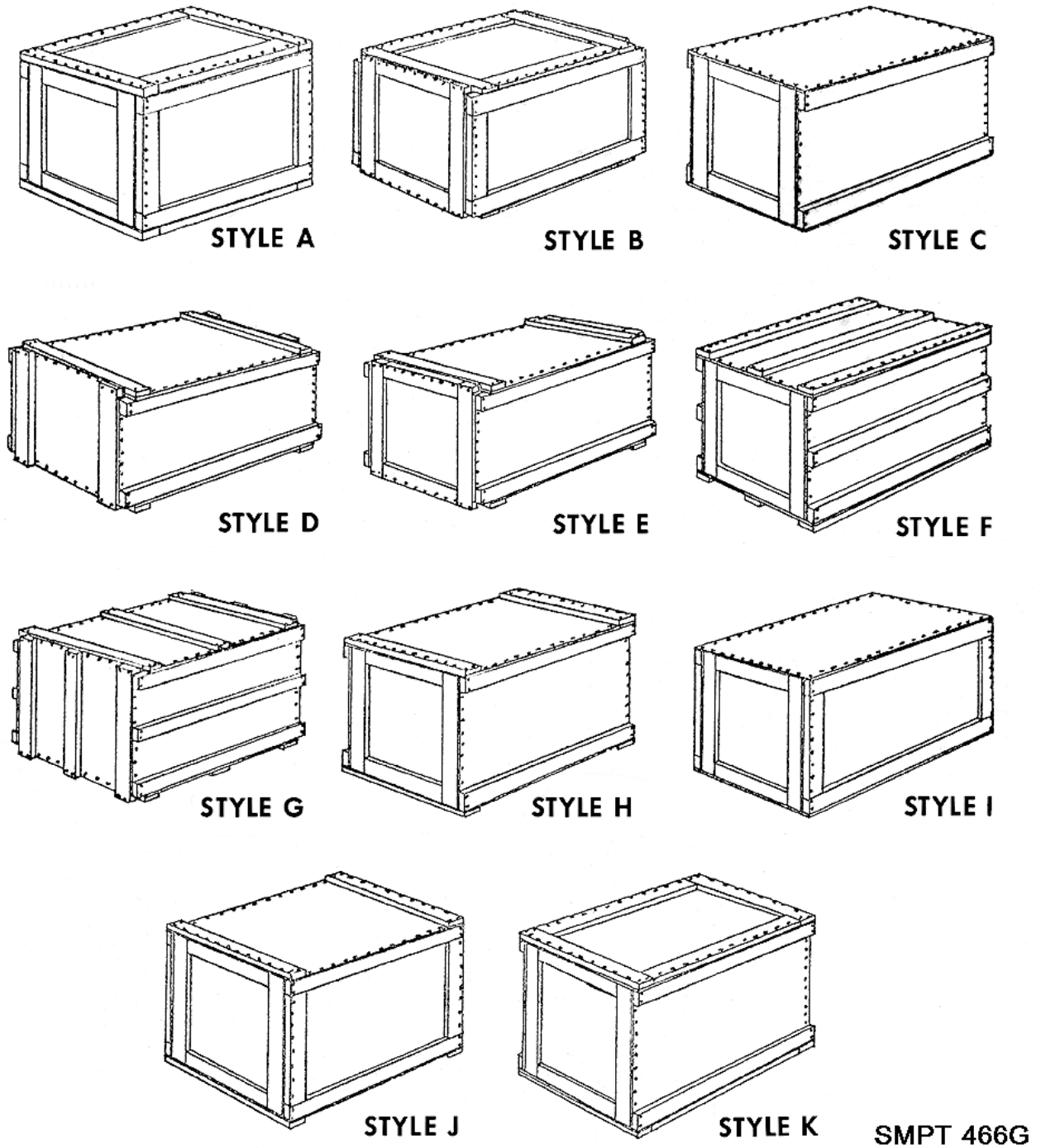


Figure 3-19. Styles of cleated panel boxes.

Table 3-12. Comparison of cleated panel boxes.

| Items of comparison | Cleated plywood (PPP-B-601) | Paper overlaid veneer (PPP-B-576) |
|---|--|--|
| Styles..... | A, B, I and J..... | A and B |
| Class of use..... | domestic and overseas..... | 1 and 2 |
| Styles, oversea..... | A, B, I and J..... | A and B |
| Styles, domestic..... | A, B, I and J..... | A and B |
| Weight limit vs. styles Oversea..... | A, B, I and J 1,000#..... | A and B - 350# |
| Domestic..... | A, B, I and J 1,000#..... | A and B - 400# |
| Types of loads vs. weight.. | 1, 2 and 3..... | Type 1 - 2 Domestic 400# Type 3 - Domestic 300# Type 1 - 2 Overseas 350# Type 3 - Overseas 250# |
| Unsupported span for intermediate cleats, maximum | Type 1 and 2 loads - 24"..... Type 3 load - 20"..... | Type 3 load, Class 2 use - 20" All other - 24" |
| Size limit Oversea..... | No size limit..... | No size limit |
| Domestic..... | No size limit..... | No size limit |
| Strapping Styles A and B..... | 2 lengthwise straps, and strap over all intermediate cleats, except cleats located on ends of plywood containers | All class 2 boxes and Class 1 when over 150# |
| Styles C thru K..... | Consult Appendix of Specification | |
| Staples..... | 4" maximum from corners, approximately 6" apart thereafter (except over bands on bottom of box for plywood) | |

Table 3-13. Plywood PS-1 and PS-51, commercial standards.

| Box type | PS-51 | PS-1 |
|---------------|----------------------------------|--------------------|
| Domestic..... | Type III, grade 3-4 veneers..... | C-D |
| Overseas..... | Type I, grade 3-4 veneers..... | C-D, with exterior |

¹Plywood is furnished unsanded. If smooth finish or snaded panels are required, appropriated sanded grades should be specified in the contract or order.

²End grain butt joints shall be prohibited for grade 4 veneers.

CLEATED PLYWOOD BOXES (PPP-B-601)

CONSTRUCTION OF PANELS

Plywood will conform to the minimum commercial standard grades in table 3-13. Plywood for domestic boxes will conform to HPMA-HP 1983, Type III, Grade 3-4, and PS-1, standard interior. Plywood for oversea boxes will conform to HPMA-AP 1983, Type I, Grade 3-4, and PS-1, standard interior with exterior glue (see tables 3-14, 3-15). If it is known that the boxes will not be exposed to the weather during storage and handling to its final oversea destination, plywood as specified for domestic type boxes should be specified. Cleated-plywood boxes are classified as Grade A, with preservative treatment, and Grade B, without preservative treatment. Plywood and cleats for Grade A boxes shall be treated with water-repellant preservative conforming to the following: 2% copper Maphthenate, 3% zinc naphthenate, and 1.8% copper-8-quinolate. Treated boxes shall be dried before shipment. Shipments of subsistence and clothing shall not be made in boxes fabricated from toxic treated plywood. If smooth finish for sanded panels are required, appropriate sanded grades should be specified. The minimum thickness of the plywood and size of cleats should be as shown in tables 3-14 or 3-15, as applicable. The plywood is attached to the cleats in the following manner:

Arrange the Cleats

Each panel for styles A and B will have two through cleats and filler cleats. Position the through cleats opposite each other at the edges of the panel material; then position the filler cleats between the through cleats at the edges. Style A and B boxes may have the top panel modified. When specified, style A shall have edge cleats and filler edge cleats placed on the underside of the top panel (fig 3-20). Style B boxes are modified by providing through edge cleats only on the underside of the panel. These underside cleats shall be of the same width and thickness as the outer cleats.

Table 3-14. Domestic type, requirements for cleats and plywood (PPP-B-601).

| Style of box | Weight of contents | | Minimum thickness of plywood | | Size of cleats ¹ | |
|---------------|--------------------|---------------|------------------------------------|--|-----------------------------|------------------------|
| | Exceeding | Not exceeding | PS-1 (see table 3-13) ² | HPMA-HP 1983 (see table 3-13) ³ | Thickness | Width |
| | | | | | All Wood groups (incl) | All Wood groups (Incl) |
| | Pounds | Pounds | Inch | Inch | Inch | Inches |
| A, B, I and J | 0 | 75 | 5/16 ⁴ ⁶ | 1/8 | 3/4 | 1-3/8 |
| A, B, I and J | 75 | 150 | 5/16 ⁴ ⁶ | 1/8 | 3/4 | 1-3/4 |
| A, B, I and J | 150 | 300 | 5/16 ⁴ ⁶ | 3/16 ⁴ | 3/4 | 1-3/4 |
| A, B, I and J | 300 | 500 | 5/16 ⁶ | 3/16 | 3/4 | 1-3/4 |
| A, B, I and J | 500 | 800 | 5/16 | 1/4 | 3/4 | 2-1/4 |
| A, B, I and J | 800 | 1000 | 3/8 | 5/16 | 3/4 | 2-5/8 |

¹At no place shall the actual thickness be less than the required thickness, minus 1/16 inch, nor the actual width be less than the required width, minus 1/4 inch.

²Alternatively low density wood plywood conforming to HPMA-HP 1983 (table 3-13) may be used.

³Low density wood plywood conforming to HPMA-HP 1983 (table 3-13) shall not be used.

⁴3/30 minimum inch thick plywood conforming to type III, grade 4 of HPMA-HP 1983 may be used in place of the 5/16 inch (3/20 thick plywood is not standard thickness in HPMA-HP 1983).

⁵Except that commercial tolerance shall apply.

⁶At the option of the supplier, 1/14-inch sanded plywood may be furnished.

Table 3-15. Overseas type, requirements for cleats and plywood (PPP-B-601).

| Weight of contents | | Minimum thickness of plywood ⁶ | | | | | | | | Sizes of edge cleats for all groups ¹ | |
|--------------------|---------------|---|----------------------|--|----------------------|------------------------------------|------------------------|--|-----------------------|--|-------|
| Exceeding | Not exceeding | Types 1 and 2 loads | | | | Type 3 load | | | | Thickness | Width |
| | | PS-1 (see table 3-13) ² | | HPMA-HP 1983 (see table 3-13) ³ | | PS-1 (see table 3-13) ² | | HPMA-HP 1983 (see table 3-13) ³ | | | |
| | | Style | | Style | | Style | | Style | | | |
| | | A&B | I and J ⁴ | A&B | I and J ⁴ | A&B | I and J ^{4 7} | A&B | I and J ⁴⁷ | | |
| Pounds | Pounds | Inch | Inch | Inch | Inch | Inch | Inch | Inch | Inch | Inch | Inch |
| 0 | 100 | 5/16 ⁸ | 3/8 | 3/16 ⁵ | 5/16 | 5/16 ⁸ | 3/8 | 3/16 ⁵ | 5/16 | 3/4 | 1-3/4 |
| 100 | 200 | 5/16 ⁸ | 3/8 | 3/16 ⁵ | 5/16 | 5/16 ⁸ | 3/8 | 3/16 | 5/16 | 3/4 | 1-3/4 |
| 200 | 300 | 5/16 ⁸ | 1/2 | 3/16 | 3/8 | 5/16 | 1/2 | 1/4 | 3/8 | 3/4 | 1-3/4 |
| 300 | 400 | 5/16 ⁸ | 1/2 | 3/16 | 3/8 | 5/16 | 1/2 | 1/4 | 3/8 | 3/4 | 1-3/4 |
| 400 | 500 | 5/16 ⁸ | 1/2 | 3/16 | 3/8 | 5/16 | 5/8 | 1/4 | 1/2 | 3/4 | 2-1/4 |
| 500 | 600 | 5/16 | 1/2 | 1/4 | 3/8 | 5/16 | 5/8 | 1/4 | 1/2 | 3/4 | 2-5/8 |
| 600 | 800 | 3/8 | 5/8 | 5/16 | 1/2 | 3/8 | 5/8 | 5/16 | 5/8 | 3/4 | 3-1/4 |
| 800 | 1000 | 3/8 | 5/8 | 5/16 | 1/2 | 1/2 | 5/8 | 3/8 | 5/8 | 3/4 | 3-1/4 |

¹At no place shall the actual thickness be less than the required thickness, minimum 1/16 inch, not the actual width be less than the required width, minus 1/4 inch.

²Alternatively low density wood plywood conforming to HPMA-HP 1983 (table 3-13) may be used.

³Low density wood plywood conforming to HPMA-HP 1983 (table 3-13) shall not be used.

⁴Top and bottom panels of I and J boxes only, all other panels as specified for styles A and B.

⁵Minimum 3/20 inch thick plywood conforming to type I, grade 4 of HPMA-HP 1983 may be used in place of the 3/16 inch thick plywood. (3/20 inch thick plywood is not a standard thickness in HPMA-HP 1983).

⁶Except that commercial tolerance shall apply.

⁷The maximum weight of contents for Air Force shipments for style I and shall be 150 lbs.

⁸At the option of the supplier, 1/4 inch sanded plywood may be furnished.

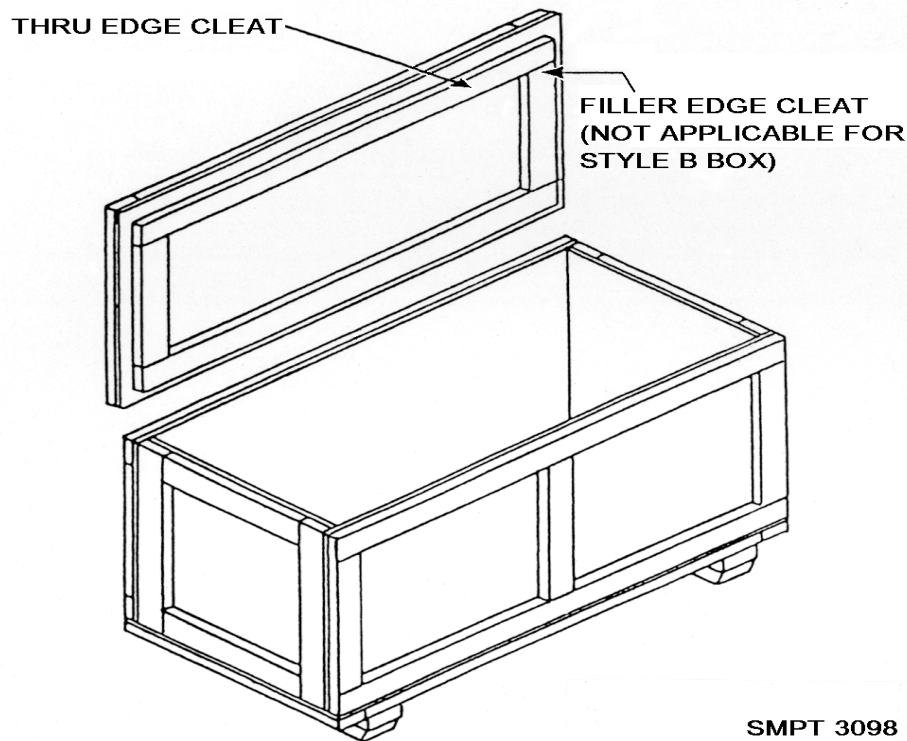


Figure 3-20. Top panel modification of unnailed closure, PPP-B-601, style A box.

Unless otherwise specified filler edge cleats shall be either the same length as the distance between the through edge cleats or approximately one-eighth inch shorter.

Filler edge cleats on top and bottom panels, except on top only when the box is provided with skids, shall be either the same length as the distance between the through edge cleats or approximately one-fourth inch shorter for oversea type boxes.

When the filler cleats are the same length as the distance between through edge cleats, each end shall be either cut at an angle or notched to provide a drainage area between the filler cleat and the plywood of approximately one-fourth inch by one-fourth inch. Drainage areas are not applicable on the underside cleats of the top panels of the unnailed closure Style A box.

Each cleat shall be a single unjointed piece.

Fasten the panel material to the cleats (fig 3-21).

Nails, staples, wire stitches, or other fasteners positioned lengthwise of a cleat are staggered in two parallel rows, approximately three-eighths inch from the edge of the cleat.

The distance between the nearest edge of a fastener and the edge of a cleat shall not be less than three-eighths of an inch and not closer than three-fourths of an inch nor more than 1 inch from the end of the cleat.

Space the nails not more than 6 inches apart lengthwise in each row. Usually, nail or staple through the plywood and then cleat and clinch. Reversal of this sequence is permitted only for nails.

Construction of Plywood Joints

In the construction of large cleated plywood boxes, it frequently becomes necessary to join sheets of panel material. Bottom panels of boxes not exceeding 72 inches in length or 48 inches in width, and top and bottom panels of Style I boxes shall consist of a single piece of plywood. All other panels shall consist of one or two pieces of plywood joined by either a lap or butt joint (see fig 3-22) as specified below. Each piece of plywood in two-piece panels shall be not less than 24 inches in length or width. Plywood joints in adjacent panels should not be closer than 12 inches of being in line.

Lap Joint

Overlap two pieces of panel material at least 3 inches. Fasten the sheet together with metal stitches through the overlap and clinch. Use not less than two parallel rows of stitches. Space stitches not less than 2 inches apart. The average spacing of stitches in each row must not exceed 4 inches. The maximum thickness of plywood to be used for this type of joint shall be 3/16 inch.

Butt Joint

Butt two pieces of plywood at the midwidth of a joint cleat. Fasten each piece of plywood to the joint cleat. The thickness of a joint cleat will be the same as an edge cleat. The width of a joint cleat for a domestic box will be no less than 2 1/4 inches. If the edge cleat is more than 2 1/4 inches wide, the joint cleat will be of the same width. For oversea type boxes, the joint cleat will be not less

than 1 1/3 times the required width of the edge cleats or never less than 2 1/4 inches.

Determine the Requirements

Additional wood cleats, of the same width and thickness as the edge cleat, are applied to an unframed area which exceeds 24 inches in any dimension or 20 inches for oversea type boxes with Type 3 loads. Additional cleats are applied to any face of a box having a load concentration near the center of the unframed area.

Fasten the Cleats

Apply cleats perpendicular to the greater of the two dimensions between edge cleats. Space and drive fastenings in the same manner as for edge cleats.

ASSEMBLY OF BOXES

Style A (Oversea)

Assembly Of The Panels

Arrange the panels so that one through cleat and one filler cleat forms each edge of the box. Arrange the cleats to form a standard box corner (fig 3-18). Arrange the top and bottom panels to overlap the sides and ends.

Nailing the Panels Together

Nail all panels to each other by single line nailing. Use either mechanically deformed, cement coated or chemically-etched nails. Space the nails in accordance with the type of load and the thickness of cleats (tables 3-16 and 17).

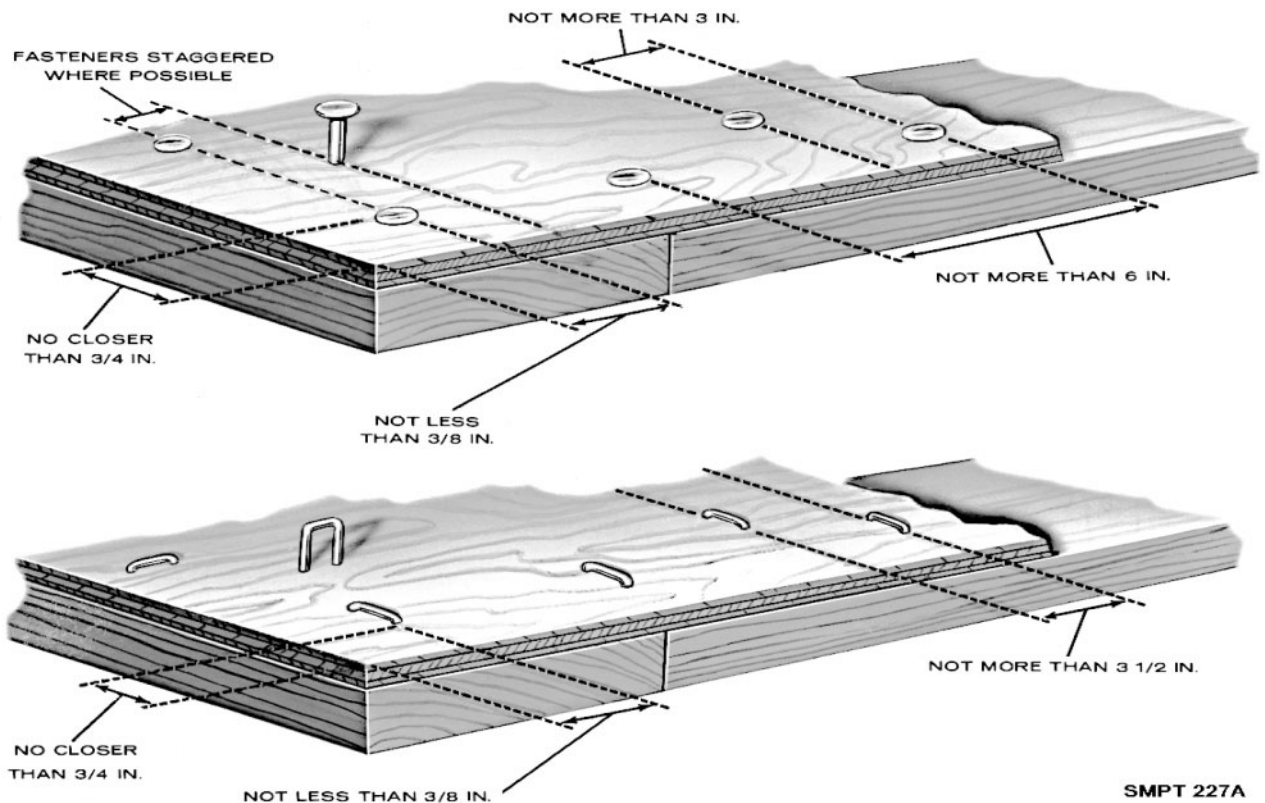


Figure 3-21. Spacing of fasteners.

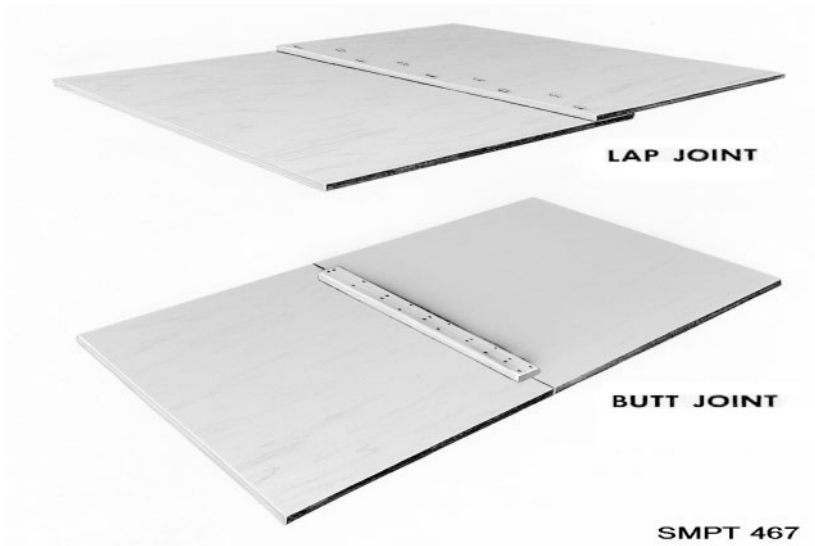


Figure 3-22. Acceptable plywood joints.

Table 3-16. Domestic type, sizes and spacing of nails for fastening together adjacent cleated panels.

| Cleats Thickness | Maximum spacing of nails all wood groups | | Size of nails for wood groups ¹ | | | |
|---------------------|---|-----------------|--|---------|---------|---------|
| | Types 1 and 2 loads | Type 3 load | I | II | III | IV |
| <i>Inch 3/4</i> | <i>Inches 5</i> | <i>Inches 4</i> | Penny 7 | Penny 7 | Penny 7 | Penny 6 |

¹If the nail protrudes through the last edge cleat or splits cleat, then the next smaller size penny nail shall be used.

Table 3-17. Oversea type, sizes and spacing of nails for fastening together adjacent cleated panels.

| Cleats, thickness (Inch) | Maximum spacing of nails, all wood groups | | Size of nails for wood groups ¹ | | | |
|--------------------------|--|-----------------|--|----------------|----------------|----------------|
| | Types 1 and 2 loads | Type 3 load | I | II | III | IV |
| <i>3/4.....</i> | <i>Inches 5</i> | <i>Inches 4</i> | <i>Penny 9</i> | <i>Penny 8</i> | <i>Penny 7</i> | <i>Penny 6</i> |

¹If the nail protrudes through the last edge cleat or if it splits the cleat, then the next smaller size penny nail shall be used.

Table 3-18. Diameter of round wire strapping.

| Weight of contents | Diameter of wire when different numbers of wire are used | | | | | | | | |
|------------------------|--|---|---|---|---|---|---|---|---|
| | 2 wires | | | 3 or more wires | | | | | |
| | 100,000 pounds per square inch tensile strength | 140,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength | 100,000 pounds per square inch tensile strength |
| Pounds | Inch | Inch | Inch | Inch | Inch | Inch | Inch | Inch | Inch |
| Up to 70, incl..... | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) |
| 71 to 125, incl..... | 0.0800 (14 gage) | 0.0720 (15 gage) | 0.0720 (15 gage) | 0.0800 (14 gage) | 0.0800 (14 gage) | 0.0800 (14 gage) | 0.0800 (14 gage) | 0.0800 (14 gage) | 0.0800 (14 gage) |
| 126 to 175, incl..... | 0.0915 (13 gage) | 0.0800 (15 gage) | 0.0800 (15 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) |
| 176 to 250, incl..... | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) |
| 251 to 400, incl..... | ..... | ..... | ..... | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) | 0.0915 (13 gage) |
| 401 to 1,000, incl.... | ..... | ..... | ..... | 0.1055 (12 gage) | 0.1055 (12 gage) | 0.1055 (12 gage) | 0.1055 (12 gage) | 0.1055 (12 gage) | 0.1055 (12 gage) |

Table 3-19. Size of flat metal bands

| Weight of contents not exceeding | Dimension of flat metal bands when different numbers of bands are used | |
|----------------------------------|--|-----------------|
| | 2 bands | 3 or more bands |
| <i>Pounds</i> | <i>Inch</i> | <i>Inch</i> |
| Up to 70, incl..... | 3/8 by 0.020 | 3/8 to 0.020 |
| 71 to 125, incl..... | 3/8 by .020 | 3/8 by .202 |
| 126 to 175, incl..... | 1/2 by .020 | 1/2 by .020 |
| 176 to 250, incl..... | 5/8 by .020 | 5/8 by .020 |
| 251 to 400, incl..... | | 3/4 by .020 |
| 401 to 1000, incl..... | | 3/4 by .023 |

Table 3-20. Size of type III, twist-tied flat metal strapping

| Weight of contents not exceeding | Dimensions when different numbers of bands are used | |
|----------------------------------|---|------------------|
| | 2 straps | 3 or more straps |
| <i>Pounds</i> | <i>Inch</i> | <i>Inch</i> |
| 70 | 0.140 by 0.031 | 0.138 by 0.025 |

Style B (oversea)

Assembly of the Panels

Arrange the panels so that one through cleat and one filler cleat forms each edge of the box. Arrange the cleats to form a 3-way interlocking corner (see fig 3-18). Arrange the top and bottom to overlap the sides; then arrange the ends to overlap the top and bottom and, finally, arrange the sides to overlap the ends.

Nailing the Panels Together

Nail each through cleat to two other through cleats at the corner with nails driven at right angles to each other. Nail the panels to each other by single line nailing. Use either mechanically deformed, cement-coated, or chemically-etched nails. Space the nails in accordance with the type of load and the thickness of the cleats (table 3-16 and 3-17).

Styles A, B, I and J (Domestic)

Four styles are available for domestic use; Styles A, B, I and J, depending on the cleat arrangement. A study of figure 3-19 shows the cleat arrangement for each style. For Styles I and J the plywood along each uncleated edge is fastened to the cleat on the adjacent panel by nails passing through the plywood and into the cleat. Nails shall not be less than 1 inch longer than the thickness of the plywood through which they pass for domestic type and 1 3/8 inches for oversea types and their spacing shall not exceed 3 inches.

Application of Skids

Unless otherwise specified, boxes with items packed therein, having a gross weight in excess of 200 pounds or length and width dimensions of 48 inches by 24 inches or more, and gross weight of 100 pounds or over, shall be provided with a minimum of two skids. The skids shall be minimum of 2 1/2 inches high and 3 1/2 inches wide. When 4-way fork entry is required, skids shall be nominal 4-by-4-inch, placed lengthwise not less than 1 1/2 inches nor more than 2 1/2 inches from the container sides and cut out a minimum of 2 inches in depth and of such width as to accommodate forks and slings for handling. Each skid shall be notched sufficiently to provide clearance for strapping. The skids shall be placed parallel to, and extend the full width of the box (the shorter of the two horizontal dimensions), and shall be set not less than 2 1/2 inches nor more than 1/6 the box length from each end. The distance between skids, measured between the inside edges, shall not exceed 48 inches. Filler cleats of the same thickness as the end cleats of the bottom panel and not less than the width of the skids shall be provided between each skid and the bottom panel of the shipping container. Additional skid(s), as required, shall be positioned so as to divide the area between the end skids into units of equal lengths. When boltholes are provided in the item, additional skids if needed shall be located so as to enable the item to be bolted to the skids. The skids shall be secured to the box by nails. The nails shall be driven through the bottom panel, the filler cleats, and the skids, and shall penetrate a minimum of three-fourths the skid, thickness. The nails shall be pallet nails having mechanically deformed shanks conforming to ASTM F 1667-95. These nails shall not protrude through the bottom surface of the skid. The nails shall be arranged in two rows in a staggered pattern, with spacing between nails in each row to be not more than 6 inches. Each row of nails shall be approximately one-half inch in from the edge of the skid and the nailing pattern shall begin and end approximately 1 1/2 inches in from the end of each skid and shall not be nailed through the strap notch.

Closure

The top panel shall be positioned and nailed. The size and spacing of nails shall be shown in tables 3-16 and 3-17. Drive nails straight to prevent them from protruding.

Strapping Requirements

Strapping requirements are found in the appendix to PPP-B-601. The sizes of round wire and flat metal straps are found in table 3-18, 3-19 and 3-20. Styles A or B boxes that have modified tops will be closed with flat steel strapping. Other means are prohibited.

Styles A, B, I and J (Oversea)

Strap Styles A, B, I and J, unless otherwise specified (see figure 3-23). On Styles A and B, apply two lengthwise straps on the edge cleats over the ends, top, and bottom. On Styles I and J, apply two lengthwise straps on the edge cleats over the ends and sides. Place a girthwise strap over intermediate